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Energy Production, January-April 1993

936B0108B Beijing ZHONGGUO NENGYUAN [ENERGY OF CHINA] in Chinese 25 Jun 93 p 27

[Text]

1993 January-April Energy Production

	Unit	Jan-Apr		Jan-Apr cumulative percentage of increase over the same period of last year
		Cumulative	Current month	
Total energy output	10,000 tons of standard coal	33043	9261	4.7
Raw coal	"	33859	9776	6.2
Unified distribution mines	"	15190	3945	-6.5
Local small and middle-sized mines	"	18669	5831	18.8
Clean coking coal	"	2008	533	-8.3
Coke (Machine coke)	"	1917.87	476.87	3.8
Crude oil	"	4750.1	1187.2	0.9
Processed crude oil	"	4273.0	1070.1	5.8
Gasolene	"	1036.6	258.4	14.8
Kerosene	"	117.4	28.2	-20.4
Diesel oil	"	1120.0	302.2	4.9
Lubricating oil	"	75.3	19.9	-7.3
Heavy oil	"	1030.7	243.4	-5.4
Natural gas	100 million cubic meters	54.5	13.6	5.4
Electric power	100 million kWh	2568.2	655.1	9.9
Hydropower	"	333.3	99.3	-3.0
Thermal power	"	2231.2	554.1	12.1

State Statistical Bureau

Three Gorges Project Enters Construction Preparation Phase

936B0117A Shanghai JIEFANG RIBAO in Chiense 27 Jul 93 p 1

[Text] New China News Agency, Beijing, 26 July—Zou Jiahua, vice premier of the State Council, being delegated by Premier Li Peng, today presided over the second meeting of the State Council's Commission on the Three Gorges Project in Beijing. During the meeting, the "Preliminary Design Report (key engineering items) of the Three Gorges" was reviewed and passed. The passing of the report formally ushered in the construction preparation phase of the Three Gorges Project.

The Preliminary Design Report (key engineering items) of the Three Gorges Project consists of 11 volumes with a total of 3 million words explaining the hydrology, geology, landscaping, distribution of key engineering items and architectural design of the various buildings, electrical engineering, construction, rough financial estimate, soil generated by the engineering work, economic evaluation and environmental protection.

According to the report, the engineering approach to the Three Gorges Project is "open navigation and three phase diversion." Single generator capacity will be increased from 680,000 kilowatts to 700,000 kilowatts. Total installed capacity will be increased from 17.68 million kilowatts to 18.20 million kilowatts, an increase of 520,000 kilowatts. Annual power output will be increased from 84 billion kilowatt-hours to 84.7 billion kilowatt-hours. Total construction time and total power generation engineering time each is shortened by 1 year compared to what was reported in the feasibility study report. Total construction time is 17 years and the first power generator's engineering time is 11 years. Key engineering projects are estimated to be 50.09 billion yuan (based on the price level of May 1993).

Zou Jiahua, the vice premier, stated that the consolidated benefits of the Three Gorges must be stressed in the informational campaigns to the people so as to let everyone in the nation understand and support the Three Gorges Project. Moreover, the vice premier said that the system of accountability must be implemented in the construction of the Three Gorges Project. Without accountability, the construction will not go well. The vice premier added that only after the preliminary design of the project has been approved and passed that preparatory work can be started as soon as possible. Therefore the

passing of the Preliminary Design Report (key engineering projects) of the Three Gorges Project by the State Council's Three Gorges Commission is very significant in accelerating the preparatory work, in shortening the engineering time, and in bringing forward the schedule for power generation. One thing still needs to be done and that is the relocation and resettlement of the residents, particularly those residents in the area where the dams are to be built. This is pivotal to the smooth preparatory work prior to the construction of the Three Gorges Project.

Discussion of Management in the Three Gorges Project

936B0109A Beijing SHUILI FADIAN [WATER POWER] in Chinese No 5, 12 May 93 pp 9-13

[Article by Liao Anrong [1675 1344 2837], Three Gorges Project Development Corporation: "A Discussion of Management in the Three Gorges Project"]

[Abstract] The bid solicitation process, project oversight, and power plant construction preparations on the Three Gorges project are discussed in order to illustrate how the competitive mechanism can be introduced and modern management techniques can be employed under a market economy, resulting in effective management of the project. Tentative suggestions on management methods are offered.

I. Realization and Management of the Project

During the realization of the Three Gorges project, the project administration has been assigned by the state to organize the design and construction activities. Once the first generator group is commissioned, the project administration not only will be responsible for administering the project, but also will be in charge of accepting, operating and managing the generator sets. At this time, the project administration will enter a stage of concurrent management of project activities and power-generating equipment operation: in addition to continuing effective work on project realization, it will be working to increase economic benefits and to pay back the investment on the project. All organization and construction work on the project, beginning with the design and preparation stage, must focus on quality assurance and the shortening of construction schedules in order to get the generator units into production and yielding benefits ahead of schedule, while construction is still under way, and in order to pay back the project investment ahead of schedule.

As a consequence, the project administration must create a favorable internal and external environment for the construction organizations, coordinate the "outer layers," and allocate funds effectively.

The Three Gorges project will make use of the competitive mechanism and of a contract system based on bid solicitation and submission; the oversight organizations will use contracts, state policy, laws and regulations, and technical standards in the oversight and management of project of project realization. The project administration, together with other enterprises that it creates, will constantly have the double responsibility of project realization and power production management, of course with the primary focus on the former aspect, and it will have to rely on the personnel of all organizations involved in order to guarantee that the overall objectives of p73 the project will be met.

When the project is completed and the facilities are put into operation, the project administration will take on the responsibility for operating and administering the Three Gorges hydroelectric stations. It will strengthen the technical and economic coordination of the project's power plants with the Gezhouba power plant and will guarantee power-production reliability and strive to increase economic benefits; it will expand the project's benefits and revenues, increase its economic strength, and pay back the investment ahead of schedule, and in addition will use its own economic benefits and strength to further promote the country's hydroelectric power effort.

II. Project Bid Solicitation and Contracting Procedure

Project activities will be organized in accordance with a state-approved preliminary project plan, an overall project deadline and an overall budget, as a basis for project bid solicitation and the awarding of contracts.

A. Bid Solicitation

In view of the capabilities of domestic construction organizations and the circumstances of the Three Gorges project, we suggest that the best means of bid solicitation for the project is the method of invited negotiated bids.

If the bid solicitation were subdivided into an excessively large number of items and was made public, many construction organizations from all over the country would submit bids, resulting in a large competition that would waste a great deal of time, money, resources and manpower. Since it is generally clear which domestic hydropower construction companies have strong capabilities, and since only a few such companies have experience with large construction projects and have fully adequate capacities, it is possible to predict in advance which organizations would win the contracts in a public bid solicitation: thus it is realistic to use the invited negotiated bid method, while retaining public bid solicitation for temporary projects associated with the main project.

B. Contracting Method

For the benefit of the project, a small number of construction organizations with experience in large projects and with fully adequate capabilities should be selected to take part in contracting for the major project components. If contracts are awarded to a large number of enterprises, they will get in each other's way in the course of construction, continuity will be poor and coordination difficulty, quality and costs will be difficult to control, and the construction process may be drawn out. As a consequence, the project administration should take the approach of having a single enterprise or a consortium of enterprises contract for each major line item of the project, an approach that is better suited to the conditions of the Three Gorges project. The "major items" are such large items as dams, locks, rail lines and the like.

Contracting by enterprise consortia will be based on mutual trust, coordination and cooperation. This type of contracting enables all parties in the consortium to supplement each other's abilities and to employ their particular

strengths most effectively. Once the consortium goes through the registration procedure, it becomes a legally constituted corporate second party with which the first party of the project can do business. In the case of organizations that have independent contracting experience and capabilities, single-enterprise contracting may also be used, in which a construction organization directly takes on tasks under the project and becomes directly responsible to the project administration. This type of contracting is effective in making use of the construction organizations' full manpower and of their potential for self-coordination, adaptability, and rapid responsiveness, and it promotes interconnectedness and continuity of the construction process, with a high degree of flexibility: thus these organizations can take the lead in certain other preparatory activities associated with the project. This method will help to assure project quality and rapid and to decrease costs and increase benefits.

To help coordinate the temporary construction projects with the main project and to further promote work on the temporary projects, the construction enterprises that contract for the major project items may be granted priority standing (subject to the requirements of fair competition) in contracting for the temporary projects; in particular, the temporary projects in their own work areas should be contracted to these organizations.

III. Project Oversight

In order to provide effective, scientific management of the project, the project administration will invite or assign state-approved, experienced specialized organizations to exercise comprehensive oversight and management of quality, timeliness and in-budget completion of project line items in accordance with the relevant norms, technical standards, and contracts. The organizations will be required to handle fairly the relationships between the project administration and the contractors, to coordinate with each other, and to jointly assure that the overall objectives of the project are met.

A. Oversight and Management Procedures

The Three Gorges project is on a large scale, with a long construction schedule, and is technically complex, in addition to affecting a wide range of organizations and entailing an immense amount of management effort. The project administration will not have sufficient manpower to involve itself directly in all of these areas of activity: it must direct its primary efforts to the effective organization and realization of the project, to macroscopic control over project implementation, and to the resolution of major technical and economic issues and questions of funds allocation. The management and oversight bodies that are recruited by the Three Gorges project administration should be able to act on behalf of the project administration, independently and fairly performing comprehensive oversight and management of project implementation.

B. Authority and Compensation of the Oversight Organization

1. Oversight Powers. The oversight organization has major responsibilities and tasks, and the project administration must give it the powers it needs for the performance of its duties. The specific duties and powers must be clearly defined by formal agreement between the oversight organization and the project administration.

2. Compensation for Oversight Activity. Because the oversight duties involve a high degree of responsibility and the tasks involved are arduous, with a certain amount of risk, the standards for compensation of the oversight organization must be commensurate with the value of its work. The project administration must determine current domestic compensation levels for oversight activities, listen to the views of all parties involved, and set reasonable compensation standards in accordance with the actual conditions of the Three Gorges project. Compensation of the persons involved in oversight work must be commensurate with the value of their efforts. To give the oversight body incentive, the project administration must award separate bonuses for effective performance or outstanding results.

C. Some Issues in Oversight Management

1. Demarcation of Project Components. Each component element of the overall Three Gorges project should be the responsibility of a single body, and there should correspondingly be a single oversight body; this will assure that the oversight duties correspond to the construction activities and run through the entire construction process, will promote continuity and connectedness of oversight work, and will increase the independence and fairness of oversight activities while decreasing the independence of the oversight body on the project administration.

2. Breadth and Depth of Oversight Activity. In the interest of effective overall oversight and management of the project, the project administration must permit the oversight units to take part in the entire project realization process, including drafting the requests for bids, soliciting bids, evaluating the bids, selecting the winning organizations, contract negotiations and signing, and contract management.

3. Quality Oversight Procedures and Personnel Qualifications. Construction experience of more than a decade indicates that the contractors themselves must have effective quality oversight procedures and systems and must be able to perform their duties effectively and control project quality. The contractors must eliminate outmoded thinking, improve the qualifications of their quality oversight personnel, manage quality oversight more closely, and cooperate closely with the oversight organizations in an atmosphere of mutual support so that they jointly carry out the oversight and management tasks. They must not under any circumstances expect the oversight organization to do all the work of quality management.

D. Conscientious Selection of Project Oversight Bodies

China's hydropower project oversight system has evolved from the first pilot experiments to its present state in less than 5 years, and there are only a few well rounded oversight organizations that have been involved in a significant number of large and medium-size hydropower projects, have abundant oversight experience, and are

suitable candidates for selection for the Three Gorges project. The Three Gorges project is on a large scale, and specialized oversight activity in such fields as scientific research, surveying, design, construction, equipment manufacture, and the provision of materials and supplies is extremely broad scope, involving complex, demanding specialized technologies. It is difficult to find oversight organizations that fully meet p73 all of these requirements. As a consequence, in the Three Gorges project, the project administration must necessarily select several units in different fields to provide oversight. In this situation it is best to designate one body as the principal organization, heading the oversight contracting group. This approach will make the fullest use of each specialty and enable the organizations to exercise their concurrent oversight duties in an atmosphere of equality and mutual trust, with full independence, and to reduce the work of the project administration.

E. Performance of Oversight Functions by the Three Gorges Power Plant Construction Preparations Office.

1. Some Thoughts on the Organization of the Joint Oversight Body. In the initial period of construction preparations by the Three Gorges power plant construction preparations office, it will be requested by the project administration to invite other units or individual oversight experts to join with it in a combined oversight group. This group will be responsible for comprehensive oversight of the project, including inspecting the quality of design and construction, collecting and organizing data, keeping informed on all aspects of the project, and assuring high-quality work and paving the way for the acceptance of the completed construction and the commissioning of the generating sets; it will take on oversight duties with respect to the first and second parties of the project in accordance with the oversight contract. The power plant construction preparations office should merge with the Project oversight body, wearing two hats in its external dealings and internally consisting of several teams. When the first group of generators comes on line and the Three Gorges power plant is ready, the power plant construction preparations office will conclude its functions as a transitional organization. At this time the management of the Three Gorges power plant will itself take on the dual responsibility of project oversight and the management of power production, thereby becoming a third party to the project.

2. Advantages of the Performance of Oversight Duties by the Three Gorges Power Plant Construction Preparations Office. The Three Gorges project is a key water conservancy project that will yield multiple benefits. But the experts and design units can evaluate the project only in terms of total investment, operating expenses, and income from power production, because the other benefits cannot be expressed in financial terms: only the income from power production can be so expressed. As a consequence, in terms of constant 1990 prices, the huge investment of 57 billion yuan on the project cannot be balanced against the full range of benefits, and the task of repaying the project investment falls entirely to the Three Gorges power plant. As a consequence, the task of operating and protecting this key project, which will be undertaken by the power plant's management, is a large and arduous one. The power plant must show the greatest concern for all aspects of work on the project, for project quality, construction schedules, and the utilization of the investment funds. Therefore the establishment of a power plant construction preparations office, with a concurrent oversight function, is a rational approach.

3. Timing of the Establishment of the Power Plant Construction Preparations Office. Experts give the following construction schedule for the project: 3 years of construction preparations, 3 years for the first stage, 6 years for the second stage, and 6 years for the third stage, for a total of 18 years. The first generating unit will begin producing power in the 12th year. But preparations for the project are already under way and have made considerable progress, and thus a full 3 years of preparation will not be required. In the Gezhouba hydroelectric project, the period from construction preparations to the beginning of operation lasted slightly more than 2 years, from 1979 to 1981. But personnel at all levels felt that the preparation period was too short, that the process of getting the equipment commissioned and putting it on line was rushed, even with the vigorous support of all parties, that living conditions, transportation conditions and working conditions for the front-line and support units were extremely difficult, and that the preparatory work was not fully adequate. The Three Gorges project involves a far greater amount of work than the Gezhouba project, and the preparation period must of course be longer. Thus, the Three Gorges power plant construction preparations office should be set up as soon as work is begun on the project.

IV. Some Thoughts on Management

A. Land Acquisition and Resettlement in the Dam Construction Zone

The state must provide legislation to assure that the management of the project has a legal basis. Land acquisition, resettlement, and the use of the acquired land must all be based on due process of law. This is a precondition for the effective completion of the Three Gorges project, including the effective management of land acquisition in the dam zone.

A comprehensive overall plan for the use of the land in the dam area must be drafted, based on project specifications and construction requirements. The plan must coordinate long-term and short-term objectives and must make comprehensive arrangements for future development, including municipal functions after construction is complete. The first generating unit is scheduled to go into operation while the project is still under way and construction activities are in progress. The overall program must take account of construction requirements and coordinate them with the needs of power production, living conditions, roads and other transport, and public security. The use rights for land in the dam zone belong to the project administration, which can issue contracts for compensated use of the land. The organizations using the land must comply with the requirements of the overall program. We

suggest that, in keeping with work requirements, an economic entity organized as a company should be set up to build the new city and to develop production in the countryside.

B. Plan Management

The project administration must draft a long-term overall schedule for construction work on the project, supplemented by medium- and short-term schedules, annual and quarterly construction plans, and annual and quarterly implementation plans. All such plans must specify focal projects during the time period that they cover and designate the key objectives and milestones to be attained; in this way, they will aid in concentrating manpower and will guarantee that the key objectives will be met and that the project will proceed steadily and in a balanced fashion.

It must participate in the development and evaluation of the project estimates and budget and in the evaluation of the bid documentation for the separate project items, and control expenditures.

The monitoring of plan implementation should take account of the dynamics of work on the project, of progress on the construction sites, and of changes in market prices, with continuous adjustment and improvement of the plan. The costs of the project will accumulate as the project proceeds and will not be constrained by annual expenditure plants. Payments should be calculated from the actual volume of work and unit prices, and the investment plan must be conscientiously implemented.

C. Contract Management

1. Types of Contracting. We suggest the practice of contracting for individual project items, in accordance with the projected budget. Particular attention must be devoted to the amounts of labor, materials and machinery used. The budgeted prices for units of labor, equipment and materials and the market price per machine-shift should be used to calculate the project costs. As a consequence, the total cost of the contract will change with the unit prices in the various stages of the project, and contract performance oversight will be carried on in a relatively objective fashion and will be managed with reference to changes in market conditions and to the dynamics of work in the successive stages of the project.

2. Contract Management. Economic activity and economic management of the Three Gorges project must be based on formal contracts. We suggest that the Three Gorges project administration should take account of the nature of work in the various trades and organizations and should make an effort to increase the effective monitoring by developing a uniform contract management procedure; as part of this procedure, line-item managers should be named and assigned to carry out specific contract monitoring, in accordance with approved procedures, of the various categories of contracts. This will help in controlling and managing the quality, timeliness, and overall cost of the Three Gorges project and will avoid confusion and errors resulting from differences in contract management procedures and standards. Contract funds should be handled by static subdivision and dynamic control on the basis of the design estimates and budget, while assuring the attainment of project quality and power-production objectives; a "tilt" policy for construction deadlines should be instituted, incentives for beginning power production ahead of schedule should be offered, and all those who attain project objectives on time or ahead of schedule while maintaining quality should receive one-time bonuses.

3. The Role of the Line-Item Manager. The work of the line-item manager in contract management consists primarily of the following: participation in organizational and preparatory activities before the bidding solicitation, in the drafting of the request for bids, in evaluating bids and selecting the successful bidders, and the contract negotiations and signing; inspection of on-site construction arrangements, of the overall construction schedule, of the monthly plans and reports, of project materials and of construction measures; monitoring of contract implementation, dealing with problems arising in the implementation of project items and the reaching of project milestones, and provision of timely assistance in solving the problems; stringent efforts to assure that on-site progress is consistent with the rate of progress specified in the contract, and examination of the charts and data provided by the construction units in order to assure continuity of construction work; monitoring of the actual amount of work done by the construction units and issuance of appropriate payment vouchers, based on the unit prices specified in the contract; resolution of disputes regarding contract implementation or disagreements arising during power production, mediation between the parties, representation of the project administration, and effective macroscopic oversight of the construction organizations' project technology and construction equipment and of the rate of progress and the quality of work.

4. Activities Related to the Project Estimates and Budget. Work with the project estimates and budget is the basis of contracting under the project. As the socialist market economy becomes established and the market for materials is opened up, market prices will fluctuate, and it must be possible to adjust the project estimates and budget in response to these fluctuations. As a consequence, work with the estimates and budgets is a dynamic activity involving responsiveness to changes in objective circumstances. The manager must therefore have a good grasp of marked data, including data on financial conditions, labor, construction, building materials, transportation and the like, and must make a conscientious and effective analysis of price differences so as to provide correct data for the drafting and subsequent adjustment of the estimates and budgets. The estimates and budgets must be effectively monitored and managed in accordance with the planned scope of the project, the total investment, construction schedules, project quality, and total materials consumption. The managers must participate in bid solicitation, negotiating and concluding contracts for particular project items, the bringing in of major equipment, price inquiries and negotiations, technical exchange, and disbursal of project line-item funds and the making of funds policy.

The oversight bodies recruited or delegated by the project administration must manage the contracts for the project in accordance with the relevant laws and regulations, specifications, and technical standards. For the above requirements to be met, the contract management departments must rely on the support and cooperation of the oversight departments, work together with them in contract oversight, and effectively manage the implementation of all contracts under the project.

D. Materials and Equipment Supply

Materials and equipment supply is an advance activity, and the high-quality provision of the required amounts of materials and equipment in accordance with the project plan is a key factor governing the quality and rate of progress of the project. Once the project is duly authorized, material and equipment supply and management become a primary task. We suggest that the project administration delegate a government body concerned with materials to carry on general contracting for materials supply and that the materials be delivered directly to the construction sites, with the construction units making the payments and taking delivery in accordance with the monthly plan for materials use. Materials orders, demands for delivery, and the transportation, transfer, reception, storage and issuance of materials should be the responsibility of the contractors.

The materials supply departments of the project administration should be responsible for: assembling the reports and plans submitted by the construction organizations; keeping informed about materials orders and deliveries; managing the delivery and utilization of materials in accordance with the plan; filling out financial accounting forms; effectively settling and clearing accounts for the construction organizations' expenditures on materials, keeping statistics, and checking off the relevant items; implementing a level-by-level system of responsibility for controlling material prices project-wide; and conscientiously controlling the overall consumption of project materials. They should collect up-to-date information on market prices and conduct regular analyses of materials-related economic activity.

We suggest that a similar approach be applied to the management of equipment supply.

It should be explicitly specified that when there are changes in the availability of materials and equipment needed by the project, the contracting organizations must be able to adapt and adjust, so that the continuity of work on the project is not adversely affected. The desire for maximum economic benefits should not lead to a temptation to ignore certain unprofitable materials or equipment so that progress on the project is hindered.

These approaches to material and equipment supply should decrease the work load of the project administration and should facilitate macroscopic regulation by its materials supply management departments.

E. Set Up Development Enterprises

We suggest that in addition to focusing on effective realization of the project, the Three Gorges project administration should also consider taking advantage of the current reform effort to set up other development enterprises and to establish an integrated service system, spearheaded by information, consulting, technical and other intellectual services, but with production services and the provision of amenities as its mainstay. These enterprises should sign contracts or performance guarantees with the relevant higher-level body (the project administration), and their responsibilities will be defined in terms of economic-benefit targets.

Experts Discuss Energy Development Centered on Construction of New Market Economy (Part 3)

936B0108A Beijing ZHONGGUO NENGYUAN [ENERGY OF CHINA] in Chinese 25 Jun 93 pp 1-4

[Text] Lei Shuxuan [7191 2885 5503] discusses the issue of energy in the market.

For a long time, electric power production and consumption in China was characterized by a system that emphasized unified distribution of electric power only, and did not further consider the electric power consumption market as a means to more fully avail unified macro guidance under a socialist market economy, nor the rational deployment of production strength, better utilization of energy resources, and practical allocation of economic benefits that are activated through the competitive market mechanism. For this reason production and economic benefits are now often in conflict between the provincial and local power grids and between provincial electric power bureau dispatchers, and the various municipal power plants and power supply bureaus. With provinces acting as entities and some municipalities planning independently, many conflicts in distribution of electric power arise, and the past method of allocating economic benefits according to measure of authority, does not accord with the principle of equal competition in a socialist market economy, nor is it amenable to a practical utilization of electric power, or a rational deployment of production strength. Research is needed on operating an electric power system to meet the needs of a market economy.

Zhai Dongjie [5049 2639 0267], on raising the quality of coal to enhance competitiveness in the market.

In letting the price of coal be governed by the rise in cost of materials and fuel operations, coal enterprises will face new problems. Besides greatly accelerating conversion of the enterprise management mechanism, reducing personnel, and improving management; raising the quality of coal and expanding the further processing of coal products, and comprehensive use of coal, will make coal enterprises more competitive in the market, and increase their profits.

(1) Actively raising the ratio of clean coal processing will reduce ash and sulfur.

At present, only 20 percent of all chinese raw coal is washed, well below that of industrially advanced countries, and the low rate of washed coal means more waste rock in coal shipments, more burden on the consumer, and wasted railway capacity. A nationwide program to raise the percentage of washed coal to 40 to 50 percent by the year 2000 to 2020 will bring it up to the present advanced world level.

(2) Increasing the number of pit-mouth power plants to transport electricity instead of coal will make exportation easier and improve the performance of enterprises. A vigorous development of pit-mouth power plants will reduce the volume of raw coal shipped out and ease the rail transportation burden. There must be continued movement away from totally coal-oriented entities toward management entities that make comprehensive use of coal with emphasis on joint management of coal and electricity. Large and middle-sized pit-mouth power plants must be developed along with development of large-scale lignite mining districts that supply power to local grids. Middle-sized power plants should be developed along with large and middle-sized anthracite mines to take advantage of the fuel at hand to supply electricity for the mining districts' own use, and for the towns and villages in the vicinity.

(3) Increasing the variety of coal products and production of various types of coal.

It is very evident that coal briquettes, whether for civilian use or industrial, save coal and reduce pollution. According to data from the National Coal University Graduate Department Coal Briquette Laboratory, coal briquettes save energy (over 15 percent), have good environmental factors (reduce coal dust by 80 percent, sulfur 60 percent, and nitre 30 percent), require little investment, are cheap, have a variety of uses, and are a practical method of coal processing.

Coal briquette fuels have a bright future for urban and rural uses, and coal enterprises will increase their profits if they make pressed-coal products one of the main objects of their comprehensive-use management mechanism. Putting various forms of domestic and industrial briquettes on the socialist market will improve the overall performance of enterprises.

(4) Making full use of mine gases and coal-bed gas reduces pollution, and has many applications.

In recent years, more than 110 mining locations have been drawing off gases during extraction, but only half have made use of them afterward, the main reason being the shortage of facilities for storing it on the surface, with the result that large volumes are expelled into the atmosphere. Therefore the following practices are suggested:

1. Full use of mine-gas pumping technology will guarantee safety of mining operations and provide useful fuel.
2. More gas pumping and storage installations, and various techniques (pumping to the bed stratum or neighboring strata), will give the best possible results.
3. Give more attention to use of energy resources through pumping and utilization of mine-shaft gas and coal-bed gas.
4. Make further use of coal-bed gas pumped during early surface exploratory drilling.

(5) Actively develop coal-gas chemical industries in the mining districts, villages and towns thereabout.

Tang Zhongnan [0781 0112 0589], on studying the question of using coal, oil, and gas for electric power generation.

Looking at the present and beyond, electricity is still the best energy for social development. Hydropower and nuclear power are necessary for accelerated development, but they can provide only a small amount. Coal, oil and gas are still the main fuels to be considered for power generation. For this reason there are several issues that should be carefully studied.

1. Analyze the extent of China's energy reserves, separated into the life expectancy of reserve volumes for coal, oil, gas, nuclear and hydropower.
2. Project electric power requirements (This question is relatively transparent).
3. Study the feasibility of using foreign energy resources, and regional distribution, including 20- to 30-year projections.
4. Study the use of foreign energy and means of getting it (direct purchase, extraction outside of country and cooperative endeavors)
5. The basic question is profit. Studying profit is a big task; small domestic profit cycles, large international profit cycles, and the interaction of those two are not simply a matter of investment input and product output, they include extraction and utilization of energy resources, and the overall effects on the social environment of the forces of change in international military affairs, politics, and economics. Research in China is still undeveloped and more work needs to be done.

A plan is being examined to see how the scattered specialist forces relevant to the above questions can be brought together through some form of organization into a systematically organized activity.

Zhang Xianhong [1728 2009 1347] discusses importing oil generators and early development of hydropower on the Jinsha Jiang.

Considering the major development that China's electric power industry will be going through and that the development of coal for electric power will be restricted by coal resources, railway transportation and environmental protection concerns, and that nuclear and hydropower will be hard-pressed to fill the gap, attention should be given to the importation of oil and gas fuels and the building of power plants along the coast to solve shortages.

Development of the Jinsha Jiang is recommended to help deal with the energy shortage situation.

As many as 19 cascade stations for a total installed capacity of 75,000MW could be built on the mainstream of the Jinsha Jiang by building 16,000MW and a total reservoir capacity of 47 billion cubic meters on the upper reaches from Yushu to Shigu; 6 cascade stations for a total installed capacity of 19,000MW and a reservoir capacity of 37 billion cubic meters, about equal to the Three-Gorges hydropower station, on the middle reaches from Shigu to Longjiang; and 4 cascade stations for a total installed capacity of 35,000MW in the near term, eventually

reaching 42,000MW, and reservoir capacity totalling 40 billion cubic meters on the lower reaches. The annual silt discharge on the Jinsha Jiang is 230 million tons, one-half the silt discharge of the Three Gorges project. With the development of the Jinsha Jiang, and Dadu He, Baobugou on the upper reaches of the Chang Jiang, and adding on to that Ertan on the Yalong Jiang (installed capacity of 3,300MW, reservoir capacity of 5.8 billion cubic meters), the flooding and silting of the Chang Jiang will be basically taken care of. Not only will that be a great benefit in itself, but the silting and flood prevention at Three Gorges will be more assured and its power volume will be greatly enhanced. The development of the Jinsha Jiang has long been considered to be a long way off, but in view of the accelerated economic development, this idea must be changed. It is imperative that consideration be given to taking advantage of the 40,000MW of hydropower resources as soon as possible, for it will be enormously useful to China's energy construction by the years 2000 to 2020.

Zhejiang Province's 20 to 30 middle-sized hydropower stations could reach a total of 2,000MW installed capacity—Fujian will have 4,000MW, Guangdong 1,500MW, Hubei 3,000MW, and Hunan 5,000MW. Added together, these large and middle-sized hydropower stations would be about 15,000MW, and spread throughout the five provinces, their overall benefit for electric power in eastern China, development of local industry, and flood prevention and navigation will be great indeed; they will provide a valuable and high quality energy resource.

Wang Dexi [3076 1795 3556] talks about nuclear power development.

(1) A legal and binding national nuclear energy policy and long-range program is needed.

For nuclear power to be developed more rapidly it must have a definitive role in China's short-term and long-range energy requirements. The nuclear power plan must also be subordinate to the general energy plan.

There is a nuclear energy development policy now, but a legally binding nuclear energy policy is still wanting.

It is not that a nuclear energy plan has not been drafted, but because a national nuclear energy policy is not yet definitive, there is no long-range nuclear energy plan with teeth in it, and therefore it is difficult to be specific and binding about any such plan. If nuclear energy's position and function in national energy development is clarified, then its share in each period of national power generation can roughly be determined, that is, if it is pretty well known what the nuclear energy plan is, then it can get a head start and it will be possible to talk about accelerating its development.

(2) Nuclear energy funds, technology, and talent.

Political factors and economic recession factors that inhibit the development of nuclear power in western countries are non-existent in China. The examination and approval procedures for nuclear power construction in some countries are tedious, but they are much better in China. From pouring the first batch of concrete for the Qinshan nuclear power plant to operating at peak load was estimated to take less than 7 years. Chief engineer Ouyang Yu estimates that, hereafter, this period will be reduced to five and one-half years. The estimated investment for the Qinshan 2nd-stage project is 5,000 yuan per kilowatt, and investments for serialized batch construction hereafter could be even lower. Each cycle of the Qinshan 2nd-stage project is as large as a 300MW cycle of a large-sized power plant, and two power plants of the Daya Bay-type still had to be imported. It is inevitable that China will have to develop its own capability to build 1,000MW power stations.

Because nuclear power requires such large investment it is more difficult to raise money for them than for thermal power, but the experience gained in raising money from many quarters for the latter applies. Access to outside channels were opened up for the 300MW Qinshan plant; and there is also the reliable course of feeding nuclear with nuclear, that is, to import and reprocess spent fuels from foreign power stations. France has a reprocessing plant that reprocessed 800 tons of spent fuel in two years, making a profit of several billion francs per year. China has the capability to design and build a commercial reprocessing plant. In the Ninth 5-Year Plan China will build a test plant to reprocess its own spent fuels, and will build a commercial reprocessing plant early in the next century.

Because of foreign public opinion that says there is no way to reprocess spent fuels and that nuclear waste pollutes the environment, many Overseas Chinese are opposed to China's reprocessing of foreign spent fuels, but actually, that is erroneous. Nuclear fuel can be recovered from spent fuels, although the separation technology is hard to come by. It is high S&T, and other countries are not at all ashamed, but proud to have reprocessing technology.

Reprocessing is an international sellers market, and nuclear power trade, including trade in the various new kinds of improved pressure-water reactor plants is a buyers market, therefore reprocessing combined with importing nuclear power technology and funds is a very reasonable idea.

The nuclear world is perplexed; nuclear specialties are not attracting students, for many reasons, but the important one is that the status of nuclear power is uncertain. If the country were willing to give nuclear power an important role in the national energy development picture, the nuclear power talent question would largely go away.

(3) Other opinions.

From the long-range point of view, China should develop gas power, because the power generating costs of double-cycle natural-gas power plants in a number of western countries is cheaper than thermal power, and because the heating efficiency of gas power is high, there is a savings in energy resources. And furthermore, the future prospects for natural gas in China are bright. Using natural gas as a raw material for nitrogen fertilizer has been little appreciated in China, primarily because gas power also requires natural gas, and from the aspect of comprehensive use, using natural gas for gas power has been more worthwhile than using it for chemical fertilizers. Secondly, because there are questions concerning overzealous application of nitrogenous fertilizers, and the use of combined nitrogen-phosphorous-potassium fertilizers has been ignored, and

there is also the farm fertilizer question, therefore the impetus for development of nitrogenous fertilizers is not what it used to be.

Ouyang Yu [2422 7122 0056] discusses nuclear power development.

The following are the advantages of nuclear power:

(1) Nuclear energy is a highly concentrated energy resource. The volume of fuel shipments for nuclear power plants is only one in several hundred thousandths of that for thermal power plants, and is not so affected by fuel transportation constraints as thermal power plants are.

(2) The advantage of nuclear power plants is that they protect the environment. Thermal power plants discharge large volumes of such noxious gases as carbon dioxide, sulfur dioxide, and nitrous oxide which are not only harmful to human health, but create acid rain and the worldwide "greenhouse effect" which upset the ecological balance. Nuclear power has none of those drawbacks. Its three radioactive wastes are sealed off and stockpiled to the maximum degree so all that remains to be discharged into the environment are very small amounts of waste water and gas. There is less radioactive discharge from nuclear power plants than from thermal power plants.

(3) Nuclear energy is the most abundant energy resource in the world. The world's reserves of uranium and thorium nuclear fission fuels, based on their energy content, are 20 times that of coal and petroleum, enough to replace coal and petroleum altogether.

In order to accelerate the development of nuclear power, in addition to national support and adoption of favorable policies, the following measures are strongly suggested:

1. Standardize and serialize nuclear power generators according to international safety standards. Using standardized units is beneficial to batch manufacturing, lowers capital construction costs, shortens construction periods, facilitates safety inspection, and guarantees the safety of nuclear power.

2. Integrate technology and trade. Import 1,000MW-class nuclear power units to offset the current crisis, and lay the groundwork for domestic manufacture of large-sized units.

3. While independently manufacturing 600MW units, China should be keeping close to the U.S. in the design of the new AP-600 unit. The AP-600 is superlative in safety design, but it is still in the design stage, and there is no manufacturing example from which to gain experience, therefore it is not now possible to set up its standard serialized development in China. But China should keep up with the technology, and try to establish technical cooperation with the U.S. manufacturers.

$25 Billion From Abroad To Build Big Power Base

40100004 Beijing CHINA DAILY in English 6 Oct 93 p 1

[Article by staff reporter Chang Weimin]

[Text] The power industry hopes to gain as much as $25 billion in foreign investment in the next 8 years, a government official said yesterday.

China is expected to become the world's fastest growing power consumer and market for electric generators, the official from the Power Industry Ministry told CHINA DAILY. Despite the country's 1.15 billion population it has a generating capacity of only 180 million kilowatts.

However, a strong power industry is needed to sustain annual economic growth of 8 to 9 percent, the official said.

The division chief, who asked not to be named, revealed that nine huge foreign-funded projects have been approved and another five submitted to the central government for endorsement.

And talks on joint ventures are underway in nearly all China's 30 provinces, autonomous regions and municipalities, he said.

In addition, an overseas-funded power station, with a capacity of 700,000 kilowatts, has been built in Guangdong Province.

More than $8.2 billion from abroad is expected for the 14 proposed power projects, one of which is solely foreign-owned.

The cash is coming from private sources in places like Britain, the United States, Indonesia and Hong Kong.

The 14 power stations are to have a total capacity of 20 million kilowatts and the generators to produce 85 percent of it are likely to be imported.

Three of the approved projects, involving some $1.34 billion in foreign cash, are being built and will generate 3.28 million kilowatts.

The other six which have received the go-ahead will have a capacity of 9.28 million kilowatts and need $4 billion from abroad. The five now being considered by the State Planning Commission will cost $3 billion from overseas and have a total capacity of 7.14 million kilowatts.

Foreign investment is urgently needed to help China achieve its goal of producing another 130 million kilowatts of power by the year 2000.

"We welcome foreign business people to start joint ventures or solely-owned projects," the official said.

He said overseas-funded power projects would receive clearance to take profits in foreign currency.

And more preferential policies are expected to come from the central government, he added.

However, the official noted that foreign investors should be prepared to share risks, such as ups and downs of foreign exchange rates, with their Chinese partners.

The foreigners involved in the approved power stations are to invest, run the project with Chinese partners for 20 years then turn their shares over to the Chinese.

By the end of 1992, China had signed $11.9 billion worth of contracts with international banks and foreign governments, enterprises and individuals for its power industry.

Japanese Invest Heavily in Gansu Oil Exploration

936B0119B Lanzhou GANSU RIBAO in Chinese 30 Jul 93 p 1

[Article by reporter Yen Ming]

[Text] Lanzhou—During a signing ceremony on 26 July, the Changqing Oil Exploration Bureau obtained a US$150 million loan, the third such loan from Japan. The loan, transferred from the Bank of China's Gansu Branch, will be used mainly to develop the Ancai oil field in the Changqing exploration area.

According to reports, the oil reserve in Ancai is preliminarily determined to be some 100 million tons. The drilling and development of the field will require US$189 million, of which US$150 million will come from a Japanese energy loan to China. This loan carries a grace period of 5 years with a repayment period of 10 years and with an interest rate lower than that provided by Chinese banks. When the project is completed and fully operational, it will produce an annual yield of 600,000 tons of oil.

Thermal Power Equipment To Be Exported to Pakistan

936B0118B Shanghai WEN HUI BAO in Chinese 5 Aug 93 p 2

[Article by reporter Ying Yanan [2019 1693 1344]]

[Text] Shanghai's electric power plant equipment manufacturing industry is on the fast track, as the Shanghai Electric United Corporation takes up its first contract for building a 320MW thermal power unit for export to Pakistan, including electrical machinery, steam turbine, and boiler, complete with auxiliary equipment and controls with an export value of over 600 million yuan, representing a strategic advance for export of Shanghai's machine and electronics facilities and products.

The Pakistan 320MW unit, China's largest capacity power plant export project, is the first large-scale power plant equipment to be exported from Shanghai. On 4 August, at the export mobilization meeting held in Shanghai, Vice Mayor Jiang Yiren, asked the relevant industrial bureaus and enterprises to work together with greater zeal to set an example for engineering on this Pakistan export project.

The Shanghai power equipment manufacturing industry, listed as a key-development industry fully supported by Shanghai, has a strong and comprehensive capability with outstanding S&T. In the last 40 years, Shanghai has produced 35,000MW of electric power equipment, one-fourth of all the installed capacity in the country. In the early 1980s, the Shanghai power plant industry imported technology for manufacturing advanced 300MW and 600MW thermal power units, and has now built a capability for producing import-class 300MW thermal power units, has a full production mission, can produce more that 3,000MW of generating units annually, and the Shanghai power plant industry is gearing up to undertake large-scale power plant projects.

It is said that the Shanghai Electric United Corporation, by taking the full contract for this export project, has earned a "birth certificate" for the Shanghai power plant industry beyond China's borders. The term of the overall contract is for 36 months, and the project will be finished and operating in 1996. Large-scale power plant export will be a great boost for Shanghai's industrial development outside of the country. The project is now in the organization stage. The leaders of the Shanghai machine-building and electronics, and instruments and meters bureaus and factories that took on this engineering and construction mission have said that they will make a solid and meticulous effort to build a superlative power plant with quality machinery, quality accessories, and quality control systems, and earn a permanent "border pass" for Shanghai power plants.

Promoting the Coal Industry in Southern Provinces

936B0095 Beijing MEITAN KEXUE JISHU [COAL SCIENCE AND TECHNOLOGY] in Chinese No 5, 25 May 93 pp 25-28

[Article by Jin Ge [6855 2047] and Tong Youde [4547 2589 1795]: "Start With Reality, Spur Development of South China's Coal Mines"]

[Text] **Abstract** We briefly analyze the preservation conditions of China's coal resources, point out that the main reason for the poor economic results in southern China's coal mines is the complex geological and extraction conditions of their coal seams, and propose the need to formulate the corresponding policies for this category of coal mines and to implement guidance by categories.

Key terms: Amount of coal resources, exploration results, comprehensive evaluation of mines, guidance by categories

I. There Are Substantial Differences in Coal Resource Conditions Between Southern and Northern China

The periods of coal accumulation in China are basically consistent with the periods of coal accumulation worldwide. Important coal-bearing strata formed during the late Paleozoic's early Carboniferous and late Carboniferous to the early Permian and late Permian periods; from the Mesozoic's late Triassic, middle Jurassic, and late Jurassic to early Cretaceous periods; and the Cenozoic's early Tertiary and late Tertiary periods. The overall trend of variations in coal accumulation basins are: large inland clastic continental surface marine coal accumulation subsidence basins—large inland subsidence basins—fault-subsidence basin clusters—small intermontane subsidence and fault-subsidence basins. The sedimentation categories of coal-bearing strata can be divided overall into the three categories of marine facies sedimentation, marine-continental interchange facies sedimentation, and continental facies sedimentation. The coal accumulation basins from the late Paleozoic are larger in scale and the sedimentation category is primarily marine-continental interchange facies with some marine facies. The scale of Mesozoic coal accumulation basins varies in size and the sedimentation category is continental facies and some marine facies. The Tertiary coal accumulation basins have a scattered distribution and are in the category of continental facies sedimentation.

Using the geodesic background and primary coal accumulation periods as a foundation, and integrated with China's administrative regions, China's coal resources can be

divided into the North China, Northeast China, Northwest China, South China, Southwest China, Taiwan, and other coal accumulation regions. The coal accumulation regions can be divided into several coal-bearing regions on the basis of differences in sedimentation environments, coal-bearing periods, geological structures, and so on. Based on a large amount of geological exploration and data revealed at producing mines, and employing the three instances of national coal field forecasting work, China's coal-bearing basins cover a total area of roughly over 1 million square kilometers. Over 95 percent of our coal resources are preserved in about 50 coal-bearing regions (coal basins or clusters of coal basins).

The negative structures that are formed independently from the medium and small coal basins in coal-bearing regions or from the isolation of structures during later periods in large coal basins are usually called coal fields (coal basins). The structural shapes and the thickness and stability of coal seams of the coal fields are mainly determined by the geodesic position on which the coal field is located, the paleogeographic environment, the interactions of structures and sedimentation, magmatic activity during the same period, and the internal and external geological stresses to which the formation of the coal field is subjected.

The temporal and spatial regularities of China's coal varieties are: the earlier the period, the higher the degree of metamorphism. The late Paleozoic is mainly moderately and highly metamorphic coal and no brown coal is seen. The Mesozoic is mainly low and moderately metamorphic coal, with some brown coal. Brown coal occupies the dominant position in the Cenozoic, and there is only a small amount of low metamorphic bituminous coal. In terms of their regional distribution, the degree of metamorphism of the coal in eastern China is universally higher and the degree of metamorphism is greater for the coal in southern China than in northern China. Low-sulfur coal is distributed mainly in continental facies sedimentation coal seams. Generally, in regions with rather thin coal seams and an unstable distribution, the quality of the coal is rather poor.

Since the formation of the coal fields, during their long geological history all of them were subjected in varying degrees to changes and transformation during later periods, especially the late Paleozoic and Mesozoic coal fields of eastern and southern China, which underwent several instances of crustal activity, with some being uplifted and eroded and others subsiding and being deeply buried, while some were contorted and some were broken up. Overall, the basic situation for China's coal resources is:

1. Concentrate periods of coal formation. The total amount of coal resources from the Carboniferous-Permian and Jurassic periods (including projected resources and proven reserves) accounts for over 95 percent of China's total coal resources.

2. There are many varieties of slightly metamorphosed coal. Long-flame coal, non-bonding coal, weakly bonded coal, and other lightly metamorphosed coal varieties account for about half of our total resources.

3. There are significant differences in the scale of coal fields. According to long-term survey data on coal resources by the Ministry of Geology and Mineral Resources, among China's 221 coal fields, there are 24 large coal fields in the Ordos, Jungar, Shanxi, Turpan-Hami, Guizhou-Yunnan, Huaihe-Huaian, Hailar-Erlian, and other coal-bearing regions whose resources comprise about 84 percent of China's total coal resources. The coal resources of the remaining 197 coal fields account for just 16 percent.

4. The coal seams are buried at rather substantial depths. Over half of our resources are buried at depths of greater than 1,000 meters. This is especially true of the plains region of eastern China, where the coal seams are very deeply buried. Only about one-third of our resources are buried at less than 1,000 meters.

5. The geographic positions and distribution of our coal resources are extremely uneven. There is more in western and northern China and less in eastern and southern China. The coal resources of a few large areas like Xinjiang, Shanxi-Shaanxi-Western Inner Mongolia, Henan-Shandong-Anhui, Yunnan-Guizhou, and others account for 96 percent of China's total. The nine provinces (autonomous regions) of the Jiangnan [south of the Chang Jiang] region account for just 0.6 percent and they have extreme shortages of coal resources.

6. In general, the geological conditions of the coal seams in north China are superior. The early and middle Jurassic, late Jurassic, and early Cretaceous coal fields have thick coal strata that are buried at shallow depths and have concentrated reserves. The Carboniferous-Permian coal fields have more extractable coal seams with gentle inclination angles and most of the structures are simple. The geological conditions of most of southern China's coal seams are very poor. There are more late Triassic coal field strata, the single strata are thin, and the coal seams are unstable. With the exception of the coal-bearing properties of the Liupanshui, northern Henan, and southern Sichuan regions being rather good, the coal fields located in Hunan, Jiangxi, Guangdong, Guangxi, northern Zhejiang, southern Jiangsu, southern Anhui, and southeastern Hubei all have unstable coal seams, most of which are quasi-laminar, lens-shaped, and nest-shaped.

II. Geological Conditions Affect the Reliability of Southern China's Coal Reserves

The amount of coal resources refers to the amount of coal in a natural state that is underground and has potential economic significance. Coal reserves are the amount of coal resources that are delineated from the amount of resources after undergoing geological survey work and that are developable and useable under present technical economic conditions. The former is mainly established on the basis of geological theory and scientific inferences and usually do not involve (or involve only an extremely amount of) survey and engineering. The latter requires the investment of surveying and engineering.

Practice in coal field geological exploration in China during the past 40-plus years has shown that the difficulty of survey work and the results (geological, technical, and economic) of surveying are determined mainly by the

complexity of the geological structures and the stability of the coal seams in the survey region.

According to over 2,000 detailed surveys, sample survey final and survey final exploration report statistics submitted from throughout China during the Sixth 5-Year Plan, there was an average of 4.3 boreholes drilled per km^2 at an average drilling depth of 304 meters, and 6.99 million tons of industrial reserves were obtained, which means there was a drilling footage of 187 meters for each 1 million tons of reserves obtained. The average depth of boreholes drilled in northern and southern China were roughly equivalent, but the results of exploration in northern China were significantly better than in the south. This includes 373 prospecting regions (drilling fields) in the nine provinces (autonomous regions) of the Jiangnan region, where the average number of boreholes drilled was 9.3 per km^2, 2.3 times the amount in northern China, and this produced just 2.24 million tons, only 27.8 percent as much as in the north. This was equivalent to a drilling footage of 1,241 meters per 1 million tons of reserves obtained, 8.3 times as high as in the north China region. In northern as well as southern China, there was an obvious indication of the objective law that good coal resource preservation conditions mean good prospecting results. In north China, Shanxi, and Inner Mongolia, the geological structures are simple, coal seams are developed, and the depth of burial is relatively shallow, so the results of prospecting were better than in Jiangsu, Shandong, Anhui, western Henan, Liaoning, Jilin, and Heilongjiang.

There are major variations in the occurrence of coal series strata in southern China, the topography and geomorphology are more complex, the exploratory drilling conditions are very poor, and the accident rate in boreholes is also higher, so the costs for drilling footage in exploratory drilling are usually 2 to 3 times higher than in northern China. When converted into exploration costs per ton of industrial reserves, they are 15 to 25 times those in north China or even higher. Moreover, it is very difficult to delineate high-grade reserves in the final results of exploration in this type of prospecting region (drilling field). Most prospecting reports only attain the extent of detailed survey final and survey final exploration. Prospecting reports on complex geological structures and unstable coal seams directly affect the use value of the prospecting reports, the investment results of coal mine construction, and the economic results in coal mine enterprises after they go into operation. In those projects that have undergone evaluation and acceptance to select the best mineshafts and where no major problems are encountered during the mine construction process, after they are turned over for production most of the mines also encounter various types of hard to clarify geological problems left over from the geological prospecting stage that interfere with normal production. One is unreliable reserves. Because the coal seams are unstable, there are substantial variations in the reserves. In certain of those with complex structures and extremely unstable coal seams, the error of the reserves can be as much as plus or minus 60 percent. The second problem is output that does not attain the design capacity. According to analytical statistics from producing mines at the prefecture level and higher in Hunan Province that were prepared by the Hunan Province Coal Institute, the rated capacity is universally lower than the original design capacity and output is also lower than the rated capacity.

III. Mine Production Costs in South China Are High and the Reserves Are Not Economical From the Input/Output Perspective

Economic benefits can be obtained only when enterprise inputs are small and outputs are large. In coal mining enterprises, where extraction is the primary factor, coal is both the "raw material" and the "product," and they are "entities" that must ensure that surface structures are not damaged by mining and protect the safety of underground chambers, tunnels, and other structures. Compared to other industries, they have many unique properties. Overall, the main ones are:

1. Coal is a sedimentary combustible organic mineral that cannot be renewed, coal varieties and coal quality are supported by geological laws, and the mine "raw materials" are both limited and leave no extra room for selection.

2. Coal seam thicknesses, seam numbers, structures, occurrences, shapes, and so on are all controlled by sedimentation conditions and structural actions. Under present mine extraction conditions, all of the coal cannot be extracted.

3. Mines have a specific service period and the sites where extraction occurs move continually toward both flanks of the mining field and toward deeper parts, production systems become increasingly complex, and greater numbers of geological problems must be probed, which causes production costs to continue increasing.

4. The working environment in a mine is horrible and all sorts of natural disasters affected by mining during the tunnelling and extraction process can occur at any time. Present scientific and technological development levels still do not have complete exploration measures and reliable safeguards to ensure the normal carrying out of extraction, tunnelling, and transportation or the safety of equipment and personnel.

5. The worse that coal preservation conditions are, the greater the number of geological problems that exist in mines.

Most of the producing mines in south China have thin coal seams with large inclination angles and high gas, which result in small extractable reserves, small shafts, low unit output, and high tunnelling rates in the mines. This problem is even more acute in the provinces of the Jiangnan region, which have shortages of coal resources. Added to the considerable difficult in clarifying complex geological problems during the resource exploration stage, the reserve rankings are low, there is substantial error, and the reliability is poor, which pose great problems for mine startup deployments, and there are many unpredictable geological factors that affect continuous operation in mine exploration and tunnelling and endanger safe production.

"Mine (Mining Region) Comprehensive Evaluation and Classification Research" used a detailed sample study of 79 bureaus (direct jurisdiction mines) and 443 mines (shafts) under the jurisdiction of the China Unified Distribution Coal Mine Corporation for comprehensive consideration of mine (mining region) production conditions, safety conditions, technical equipment conditions, economic conditions, external conditions, and other comprehensive assessment results to show that the ranking for 20 of its 26 bureaus (direct jurisdiction mines) in southern China was after 50th place and that with the exception of the four bureaus at Panzhihua, Songzao, Panjiang, and Shuicheng, all of the others are mining regions that have relatively poor conditions. They include the mining regions in the coal-short provinces of the Jiangnan region whose nine bureaus all have poor conditions, one-third of them category IV and two-thirds category V.

Because of the complex geological conditions of the mines in south China, they have coal but it is hard to extract. They have a high tunnelling rate per 10,000 tons, a low work face efficiency, poor technical equipment, too many personnel, and raw coal production costs that are generally 30 to 50 percent higher than in the mines of north China. Some are even double or more. In a situation of industry-wide losses for coal, the amount of the losses in south China is generally 30 to 50 percent higher than in north China. Thus, from the perspective of inputs and outputs in the enterprises themselves, the reserves in south China's mines are extremely uneconomical.

IV. Start With Reality, Implement Guidance By Categories, Promote the Existence and Development of South China's Coal Mines

Coal is China's primary energy resource and the lifeblood of the "four modernizations." The provinces of south China have placed active development of coal in an important position in order to spur the development of industry, agriculture, and communication and transportation industries in their province (autonomous region). This is especially true of the nine provinces (autonomous regions) of the Jiangnan region. Although the geological and extraction conditions of their coal seams are extremely poor, they still advance in spite of the difficulties and have all attained a utilization rate of about 70 percent for their proven reserves. This means that most of the reserves provided by geological reports can be utilized if mines can be built. This unavoidably poses many difficulties for coal mine production. The investment per ton of coal extracted from the shafts is very large and it is still hard for the enterprises to obtain economic benefits. Moreover, as the depth of the extraction moves deeper, the losses become ever more serious. During the past few years, to adapt to the new situation of reform and opening up, the coal bureaus and mining bureaus of the provinces (autonomous regions) of southern China have used a conscientious review of their arduous course in developing the coal industry as a foundation for integration with their own characteristics and are using full research on rational development and utilization of coal resources in the future to provide many good countermeasures, some of which have already been turned into forces of production. We feel that the points of experience below have reference value for the formulation of resource policies, technological policies, and economic policies for the coal mines of southern China:

1. Prospecting work must adapt to local conditions. Regions where the coal resource preservation conditions are poor, especially several small mining areas in the Jiangnan region, should not adopt conventional prospecting methods. For example, comparative analysis of certain mining areas in Hunan by the relevant scientific research units shows that the Hunan 4th Team drilled 88 boreholes in a certain prospecting region in 1971 at an exploration cost of more than 1 yuan/ton. In contrast, the Chenxi Caojiaren Mine combined production with coal prospecting. The state invested just 66,400 yuan and produced a total of 69,400 tons of coal in 3 years, at a production cost of less than 1 yuan/ton. In addition, during the past several years Guangdong's Coal Field 2nd Team has made full use of existing geological data from small producing mines in conjunction with a small amount of surface exploratory drilling projects to conduct a survey of the Longtan coal system over an area of about 100 km^2 in Yangshan County, and they have provided over 30 million tons of class C and D reserves at shallow depths that can be used by small mines. Analysis of statistics by the Guangdong Province Coal Field Exploration Company indicates that usually, prospecting along a strike 1 to 2 kilometers long with a depth of burial less than 300 meters for a mine area with a small mine that produces 30,000 tons per year for 10 years costs about 300,000 yuan, which is economically rational. Now the Guangdong Province Company's prospecting methods, borehole deployments, reserve grade proportions, content requirements for geological reports, and so on for small coal mines have now formed a preliminary set of complete stipulations that are being continually revised and perfected through practice.
2. Mine types must be adapted to geological and extraction conditions. The geological structures are complex in most of the mine areas in south China and they have unstable coal seams, so it is hard to form conventional work faces. For this reason, output from stopes often becomes the key that restricts a mine's production capacity. Production practice in all of the provinces of the Jiangnan region has proven that smaller mines are better than large ones. According to statistics from Fujian, the capacity utilization rates are highest in the province's small mines that produce 30,000 to 60,000 tons/year, while output at most mines larger than 90,000 tons/year does not attain the design capacity and their capacity utilization rates average just 70 percent. In Hunan Province, 85.8 percent have a design capacity of less than 150,000 tons/year. According to research done by experts in that province, only when the primary extraction coal seams are moderately thick ones and the coal seams are relatively stable, when there are relatively abundant reserves, and when the dimensions of the mining area and initial deployments permit two mines extracting simultaneously should consideration be given to mines of 210,000 to 300,000 tons/year, with consideration in some cases for more than 300,000 tons/year. Mines which have average coal thicknesses of about 1 meter with clusters of unstable thin and moderately thick coal seams can only deploy one mining region and recovery at 2 to 3 conventional work faces. With an additional approximately 20 percent from coal

produced in tunnelling and residual mining faces, the best type of mine is 60,000 to 150,000 tons/year. At mines which have a single thin coal seam or geologically complex clusters of thin coal seams, the mine type should be smaller than 60,000 tons/year. This idea of not simply determining the type of a mine based on the amount of reserves a mining area has is undoubtedly correct.

3. Focus closely on undertaking mine geology work for production. The degree of exploration is low in the mining areas of south China and many geological problems are left over for mine extraction. During the extraction process, geological work is obviously even more important and urgent. Many coal mines in Fujian Province have made full use of the information revealed from mine passageways to strengthen comparison of coal and rock strata, straighten out geological structures, and summarize the configurational characteristics and variational regularities of extractable coal seams, with good results in every case. For example, because the Subang Mine gained a fundamental grasp of the mine area's geological characteristics, the tunnelling rate per 10,000 tons dropped by an average of 15 percent a year between 1987 and 1989, the amount of coal controlled by passageways increased by 18 percent a year, and the mine's production has become increasingly active. They call this method two-times development work for mine geology, and it has universal reference value for the small mines of the Jiangnan region. The main coal seam being extracted at the Liguo Mine in Jiangsu's Yancheng Mining Bureau has coal lumps of varying sizes that were formed through compression by magmatic intrusion. During a long period of extraction practice, they have gradually summarized a set of "first prospecting and then extracting, prospecting while extracting, prospecting for the purpose of extracting, integrating prospecting with extracting" feathered prospecting and extraction methods based on the preservation conditions of the coal lumps. While they are still using blast extraction to mine the coal clumps, the idea is new and the technique is an original one. This is especially true of their fusing of geology and extraction, which is very deserving of imitation.

4. Take the route of using S&T to invigorate mines. The Yancheng Mining Bureau produces over 400,000 tons of raw coal each year. The four mines under its jurisdiction are extracting leftover coal and residual coal that has extremely complex geological conditions. For the past several years this bureau has integrated with its difficult production points, cooperated closely with the relevant institutions of higher education and scientific research units, organized attacks on key S&T problems, established projects that produced results during the same year, and reduced raw coal production costs each year, with extremely significant economic benefits for the enterprises. On the basis of setting aside 0.2 yuan per ton of coal it produced in the past, this bureau doubled this amount again during 1993. The Hunan Province Bureau conscientiously summarized the use of single hydraulic columns in the Lianshao Bureau to increase unit output per work face by 993 tons/month, increase work efficiency by 13 percent, reduce pit water consumption, and attain effective control of roof accidents. Hongwei Mine used experience at Danjia percussion mine to implement a progressive coal extraction method on a trial basis that substantially reduced the number of gas eruptions and the amount of eruptive coal, implemented blast mining conveyor transport on a trial basis Shenjiawan Mine, which reduced repetitive labor by workers, and so on as a basis. The relevant leaders have indicated that in dealing with technical progress, if something is economically rational, safe and reliable, and technologically advanced, a bold decision should be made, especially if it can reduce inputs and produce greater outputs. This idea is extremely far-sighted. Being willing to invest in S&T and increase the S&T content per ton of coal produced will certainly bring vitality to enterprises.

Furthermore, the experiences of many provinces (autonomous regions) in south China in focusing on the present and taking the long term into consideration for rational development of the coal resources of their province, combining coal mining with searching for coal, guiding small coal mines in safe and rational extraction, raising capital through a variety of channels to conduct geological extraction and new mine construction in a planned manner, and other areas all deserve attention.

Western Inner Mongolia 500KV Transmission Project

936B0117B Beijing RENMIN RIBAO OVERSEAS EDITION in Chinese 2 Aug 93 p 1

[Article by reporter Zhao Xinbin]

[Text] New China News Agency, Beijing, 31 July—Work on the first 500KV transmission line of the Western Inner Mongolia 500KV Transmission Project, one of the key projects of the Eighth 5-Year Plan, which will export electricity to the Beijing-Tianjin-Tangshan area, formally began a few days ago. According to reports, this is an important step in exporting electricity from west to east, in relieving the power crunch in the Beijing-Tianjin-Tangshan area, particularly the Metropolitan city of Beijing where the power crunch problem is becoming increasingly critical.

This power line stretches from the Fengzhen power plant in Inner Mongolia in the west to the Shalingzi power plant in Hebei Province in the east, a distance of 180.5 kilometers. Total construction cost is 240 million yuan. Construction work is expected to be completed and the power line fully operational by the first half of 1994. The power line, when completed, will be linked to the now completed 500KV power line from Shaling to the Changping district of Beijing. When completed, this power line will export 500,000 to 1 million kilowatts of power to the Beijing-Tianjin-Tangshan power grid.

Inner Mongolia, rich in coal resources, hopes to attract other provinces and cities to Inner Mongolia to construct and manage power stations.

At present, an agreement has been reached between the Inner Mongolia Autonomous Region, Metropolitan Beijing and the Ministry of Electric Power to jointly construct and operate power generation facilities. According to the agreement, by the end of 1995, 1.5 million kilowatts of

electricity will be exported from the Inner Mongolia energy base to Beijing and Beijing will invest in joint ventures to build power plants in Inner Mongolia and to build power transmission lines. A total of 1.4 billion yuan will be invested in Inner Mongolia by 1995.

Sichuan Steps Up Pace of Power Construction

936B0118A Chengdu SICHUAN RIBAO in Chinese 20 Jul 93 p 1

[Article by Lu Daobin [0712 ,670 2430]]

[Text] In order to help put an end to the power shortage situation and assure an increase of 350MW of generator units become operational this year, the Provincial Electric Power Bureau has concentrated limited funds to guarantee key projects, and used every means to step up the pace of electric power construction. Despite limited funds, 471.35 million yuan in investments were secured in the first half of the year.

Electric power projects now under construction throughout the province amount to more than 6,000MW. In order to guarantee that the No 2 150MW unit of the Tongjiezi power plant and the first 200MW unit of the Huangtongzhuang power plant come on line within the year, the Bureau brought personnel from the relevant offices and departments onto the Tongjiezi and Huangtongzhuang worksites to integrate deployment and direction, supervise quality in engineering, assist construction units is solving problems as they arise, and keep construction on schedule.

To solve the financial problem, the Provincial Electric Power Bureau set up a team to get the construction funds in place through specifying responsibilities and investment channels, and individually requested remittances from relevant departments and corporations, in order to get the funds in place as quickly as possible. Meanwhile, it was ruled that those engineering projects going operational would be guaranteed, and ordinary building projects would be postponed; major technological conversion projects would be guaranteed, and other technological conversion projects would be postponed; and on-going engineering projects would be guaranteed, while building projects just starting up would be postponed. As funds on hand were very tight, the Bureau made practical deployments, raised funds from inside enterprises, and advanced only 30 million or more yuan for the Huangtongzhuang power plant. The entire Bureau raised nearly 100 million yuan of its own funds for key thermal and hydropower engineering projects and expenses for work done out of schedule. Other efforts were also made to raise funds for electric power construction by bringing in domestic and foreign investments with impressive success, and in the last year over ten domestic corporations signed cooperative agreements and contracts for electric power, and foreign cooperative agreements and contracts investments topped U.S.$1 billion.

In the first half of this year, the external environment was especially bad, but the Bureau was still able to guarantee a semblance of progress in key engineering and construction. A 72-hour test run of the No 2 unit of the Tongjiezi power plant was completed without a hitch on 28 June, and preparations are in order for installation of the No 3 unit. The boiler pressure test and the cover for the low-pressure steam turbine for the first 200MW unit of the Huangtongzhuang power plant are finished, and within the year it will be sending power to the grid. The Ertan, Baozhusi, and Taipingyi hydropower projects and the Chongqing and Baima technological conversion projects are progressing smoothly.

Shanxi Electric Power Output Sets Record

936B0119C Taiyuan SHANXI RIBAO in Chinese 3 Aug 93 p 1

[Text] In the first half of this year, the province's electricity workers worked hard to implement and promote the development strategy of moving away from exporting coal alone to exporting both coal and electricity simultaneously and as a result, economic and technical indicators of power output greatly exceed the specified targets for the first half of the year. Total power output from the province was 20.5 billion kilowatt-hours. Total power sold was 12.3 billion kilowatt-hours and total exported power was 5.1 billion kilowatt-hours. These figures represent a growth of 10.05 percent, 9.58 percent, and 18 percent respectively over the same period last year. The power-output-to-coal-consumption ratio is 1 kilowatt-hour to 449 grams of coal and line loss is 8.65 percent, which represent a drop of 8 grams and 0.43 percent respectively over the same period last year. For the province's electricity bureau, the average per capita power production was 33,309 yuan, a growth of 9.6 percent over the same period last year. A profit of 96.5 million yuan was made. All economic indicator records have been broken.

Henan Power Development Plan Reviewed

936B0119A Zhengzhou HENAN RIBAO in Chinese 1 Aug 93 p 1

[Text] "Follow through on the plan," "3.5 million kilowatts operational in the Eighth 5-Year Plan and 10 million kilowatts installed capacity in the year 2000 and fighting for a little more"—these are the main themes of the province-wide electricity working conference which ended 31 July.

During the last few years electricity generation has developed at a rapid pace, putting the province in the leading position among the four provinces in central China in terms of installed capacity. In the first half of this year, total power generated in the province increased by 12.3 percent over the same period last year, putting the province in first place in the central China power grid which covers Hubei, Hunan, Jiangxi, and Henan provinces and also exceeding the national growth average. However, during the process of power generation development, a series of difficulties, one of them being acute capital shortage, have been encountered. These difficulties forced interruptions in the projects and hampered the development of power generation development. The low percentage and late arrival of capital presented great difficulties to the projects. Nevertheless, the massive number of electricity workers are not discouraged. They were determined to do their best to complete the electricity projects scheduled for the year while at the same time completing or exceeding the electricity production tasks. Toward this end, five approaches were proposed: Organize the people

to raise and collect the required capital and to get the capital from all sources in time for the projects; to develop potentials from within the industry, to raise capital for emergency situations; tighten the Electricity Development Fund, to collect arrears so that money can be loaned out again; request co-operation and support from all sources and to finance projects; request all engineering and building units to co-operate fully in a common cause, to work their best to keep to the engineering schedule assuming the on-time arrival of capital and resources and to get back the time lost due to engineering delays for the lack of capital.

Yao Zhongmin, deputy governor of Henan Province, pointed out during the province-wide electricity working conference that this year is a pivotal year in the completion of the goals of the Eighth 5-Year Plan of 3.5 million kilowatts. "Though we are faced with difficulties such as lack of capital, we should not lose sight of the fact that macroeconomic regulations and controls provide a good opportunity for the development of electricity industries," he added. "The provincial government puts great emphasis on the development of electricity industries and will do everything possible to complete the task of developing electricity," he pointed out. He said that the power generation unit is an enterprise and electricity is a commercial commodity and whoever uses electricity needs to pay. The enterprise, as such, cannot feed on the government's rice pot and cannot feed on other enterprises' rice pot. He requested the electricity department and workers to carry out their responsibilities to the full and follow the government's regulations and collect the outstanding bills on electricity.

Shuikou's First Generator Joins Grid

936B0123B Beijing RENMIN RIBAO in Chinese 9 Aug 93 p 1

[Article by reporter Zhang Ruisan of New China News Agency and our reporter Pan Didu]

[Excerpt] Fuzhou, 8 Aug—One of China's key national building projects and the largest hydroelectric power station in East China—the Shuikou hydroelectric power station in Fujian Province—has its first 200,000-kilowatt generator operational today and joined the power grid this morning. Zou Jiahua, Politburo member and vice premier of the State Council, presided at the ribbon-cutting ceremony to declare the hydroelectric power station operational.

The Shuikou hydroelectric power station is located in Xiabu village, Minqing County, in the middle course of Minjiang. Total installed capacity is 1.40 million kilowatts, consisting of seven generators each with a capacity of 200,000 kilowatts. Total average annual output is 4.95 billion kilowatt-hours. Total investment for the project is 5.6 billion yuan, of which US$240 million is a loan from the World Bank. The project is expected to be completed in 1995.

The Shuikou hydroelectric power station is China's first large hydroelectric power station open to and built by international engineering bidders. The station was built by the Fujian Huatian Construction and Engineering Company, a joint venture company consisting of the Fujian Hualian Engineering Company and the Japanese Maeda Industrial Corporation. [passage omitted]

Zhejiang Develops Coastal Power Plants

936B0115A Hangzhou ZHEJIANG RIBAO in Chinese 13 Jul 93 p 2

[Article by reporter Chi Quanhua [6688 0356 5478]]

[Text] [Excerpts] [passage omitted] In the past century, especially in the last 44 years since the revolution, electric power in Zhejiang mushroomed to 7,710MW of installed capacity, with an annual per capita consumption of up to 704 kWh, 400 times more than it was just before the revolution. During the last 10 years the average annual growth in Zhejiang has been above 10 percent, well ahead of fraternal provinces and cities in the east China network.

The steep rise in consumption of electricity illustrates the vigor of economic development.

But, electric power construction in Zhejiang still cannot keep up with the province's soaring economic development. A great gap is opening up between the lines on the graph that chart their ascents.

From 1978 to 1991, the average annual increase in Zhejiang's domestic gross output value was 12.6 percent and the growth of installed capacity for the same period was 9.5 percent. Zhejiang is forced to buy some electricity from the eastern network at a high price, but that won't be enough in the long run, and so it will be forced to put the brakes on consumption. In economically developed areas, every kWh of electricity can translate to an output value of 10 yuan, more or less. The estimated electric power shortfall for the whole province this year is 3 billion kWh, which means from this alone the loss to industrial output value will be tens of billions of yuan!

It must be said that this is only a present or static calculation. Without a major breakthrough in the electric power industry by the beginning of the next century it will be way behind development, and the "bottleneck" will get ever more "stringent".

The power shortage on the entire eastern power network will also be getting ever more serious the whole time. Jiangsu, Zhejiang, Anhui, and Shanghai, an area less than 4 percent of the whole country, has over 25 percent of the gross value of industrial and agricultural output of the whole country. Frequent power restrictions will not only seriously affect the normal order of production and livelihood, but it will cripple the strategy of making this "golden triangle" area the springboard for China's economic development at the turn of the century.

The way out is to build a line of large-scale power plants.

Power experts, having used three methods of calculation, conclude that if Zhejiang's economic development targets are reached by the end of the century, the highest power consumption loads will be 12,000MW, annual consumption needs will be 70 billion kWh, and the requirements for the whole of east China will be even greater. The locations along the coast of Jiangsu and Shanghai where power plants can be built are largely laid out, therefore power experts are looking to the coast of Zhejiang.

Zhejiang lacks coal and has little oil and more than 10 million tons of coal are now being used for generating power, all of which is sent down from the north. Rail transportation is already under great stress. It is easy to foresee what the transportation worries will be if a coal-powered energy base is to be built in Zhejiang. For that reason the country has, in the past, placed emphasis on the building of pit-mouth power plants. Now the time is ripe for large-scale development of harbor power plants along the coast of Zhejiang in as much as the State Government has opened a second corridor for exporting large volumes of Shanxi coal through Qinhuangdao to be shipped southward by sea. This is a godsend for Zhejiang which has numerous deep-water harbors and bays along its coastline.

The majority of Zhejiang's coal-power plants are now concentrated along the eastern seaboard. The Zhenhai, Beilungang, Taizhou, and Wenzhou power plants provide great around-the-clock power for the economy of Zhejiang. The Qinshan nuclear power plant now under construction is another rising star. In addition, the large-scale coal power plants and nuclear power plants on the shores of Xiangshan Gang, and Sanmen, and Yueqing Wan are about to step off of the drawing boards. [passage omitted]

Below Yinglong Shan the peaceful waters are deep and wide, and 35,000-ton vessels can bring coal from Qinhuangdao directly to Xiangshan Gang, and enter the harbor with the tide. Only 1,200 meters from the plant site is Lupu mountain valley which can be used as an ash dump, or nearby a water impoundment area could be built where ash could be dumped for 40 years. The Meixi reservoir with a capacity of 26 million cubic meters, which is to be built at a location 14 kilometers from Yinglong Shan, can serve the power plant. Experts have determined that the conditions of this location are ideal for building a large-scale coal power plant with four 600MW units, with room for expansion. [passage omitted]

Across Xiangshan Gang where Wusha Shan stands in Xiangshan County, and also westward along the coast from Wusha Shan to the end of the harbor at Qiangjiao in Ninghai County are two locations were coal power plants with over 2,400MW installed capacity are to be built. The plant sites have large spreads of flat land that can be reached by 35,000-ton coal vessels. Here the channels are protected from the wind. About 10 kilometers from these plant sites are the Pingtan, Gexizhang, Yangmeiling, and Changbanling reservoirs which are built or under construction and can supply the water needed by the power plants. There are two towns very close to the plant sites, Xizhou, and Xiashan, and two county seats within 25 kilometers, so the logistics bases for the plants are assured. Xiangshan wants to build a major bridge near Wusha Shan which will cross over Xiangshan Gang and shorten the distance to Ningbo by 45 kilometers. The Wusha Shan plant site has been an enclosed tideland for nearly 40 years, and at least three 35,000-ton piers can be built along the shore. There is a 3,000-ton pier on the Qiangjiao plant site at Ninghai which could be upgraded during construction of the power plant and a 35,000-ton pier could be built with a loading bridge only 700 meters long.

Each of the three power plant sites along the Xiangshan Gang has its special qualities, but nothing to lead the experts to favor one over the other or to discourage outside investors. At the 1993 Zhejiang investment talks held last month, the Xiangshan Gang No 1 and No 2 coastal power

plants were equally hot investment items, and the talks were lively. Once that dream becomes reality, the installed capacity of this one place alone can top 7,000MW and double the current power output of the whole province, and relieve the power shortage in Zhejiang. Xiangshan Gang will become known throughout China as the "electric power harbor." [passage omitted]

Jiantiao harbor, located in the center of Sanmen Bay, is one of the four major deep-water harbors in Zhejiang. After liberation, and especially in the 1980s, this place became a large-scale aquatic products and fruit-growing area, but still far from the "industrial and commercial mecca" envisioned by Sun Yat-sen in his "General Plan for Building China."

Beginning in June 1983, waves of electric power experts came, and all were enormously impressed by its potential as a harbor power-plant site.

Southward from Sanmen, a nuclear power plant with 4,000MW to 6,000MW units could be built at Jiantiao; Yangshitu and Niushantu could both accommodate coal-fired electric power plants of 2,400MW installed capacity or even more, and a second nuclear power plant could be built at Ketang Shan. The four taken together would rival the massive Three Gorges project, make the Sanmen coast an important electric power base, and be the catapult for economic development of Zhejiang and the whole of east China as well.

From the top of Maotou Shan at the north end of Sanmen, the sea is visible on three sides and Qingshan lies to the north. At the foot of the mountain is Talu Bay with 10,000 mu of beaches on either side, there are two barren hills symmetrically placed where the main structures for the Jiantiao nuclear power plant will be built. Experts say the Sanmen water system has five harbors and eight rivers, and Sanmen Bay's shores and navigation channels are stable, the deep water harbor branches are well preserved, the geological structure is stable. There are no large enterprises or dense population in the vicinity of Maotou Shan, the atmosphere and tidal flow are good for dispersement, and there could not be a better place for a nuclear power plant.

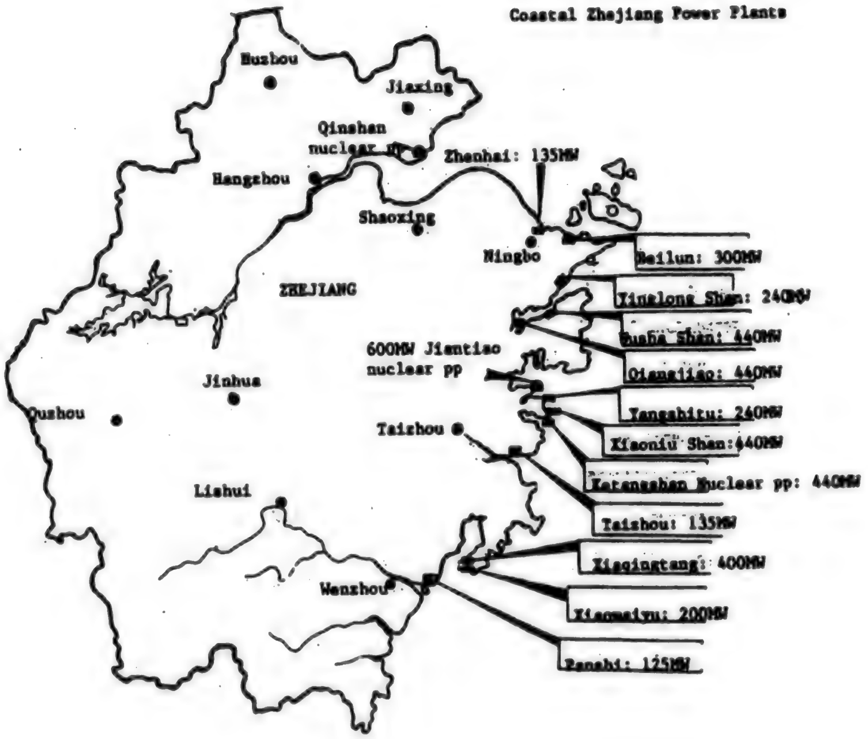
The Yangshitu power plant is located 3 kilometers east of Jiantiao. There is a sea wall 2,000 meters long that can enclose a 4,000-mu impoundment area with a coal yard on the north end and the plant in the center with more than enough space for a 2,400MW unit. The entry to Jiangtiao harbor is 800 meters east of the coal yard where the water is 12 to 15 meters deep, providing suitable berthing for three 10,000-ton- piers. Niushantu, nearby, and Chongyaotu, farther away, mark off a wide area of over 10 square kilometers where space for dumping ash is unlimited. The Niushan plant site, near Yangshitu, has mountains on three sides, and is surrounded by a 1,500-meter sea wall, where there is a 2,600 mu plant site which not only does not encroach on farm land, but can reclaim farmland when enclosed. Facing on the sea, it is both protected from typhoons and convenient for building a harbor, and the navigation channel can admit 35,000- to 50,000-ton vessels. Fresh water is abundant and close by, environmental conditions are excellent, hooking up to the power grid will be easy, land and water lie all about, and once started its prospects will be unlimited.

Along the southern coast of Sanmen, at Ketangshan on a small outlying island is a site for a nuclear power plant, found by a team of experts, with a wide beach and solid rock base, good geological conditions, but unsuitable for farming, with good climate and environment, a good south-north complement to the Jiantiao nuclear power plant.

South of the "electric power city" of Sanmen, at the southern end of Taizhou Prefecture in Yuhuan County, alongside Yueqing Bay, is the site for the Xiaqingtan thermal power plant. Its 10,000 mu of barren flats which stretch beyond view, and its famous Damaiyu harbor, is a spot favored by electric power experts. A 100,000-ton or larger coal pier could be built there, and even if an installed capacity of 480MW were to be put in the plant it would be like "putting fine timber to petty use", and when fresh water comes in, it will be in its heyday.

Zhejiang has always been regarded as an energy poor province with no coal and little oil, but that judgement is in for a change now that its coastal energy advantages can be seen. With all of the changing conditions coming together, Zhejiang, once energy poor, will become a major province for secondary energy. The Beilungang and Zhenhai power plants, and also the Wenzhou, Taizhou, Jiaxing, and Qinshan power plants are the evidence, and the large-scale expansion and later-stage construction of this group of coastal harbor power plants will continue to prove it. Early in the next century, after the arrival of the seven large-scale thermal power plants and the two large-scale nuclear power plants, the two large-scale power plants at Hangzhou Bay, the five new large-scale hydropower stations inland, and the six large-scale pumped-storage power plants, power shortages will be a thing of the past.

Coastal Zhejiang Power Plants



Shanxi Steps Up Power Plant Construction

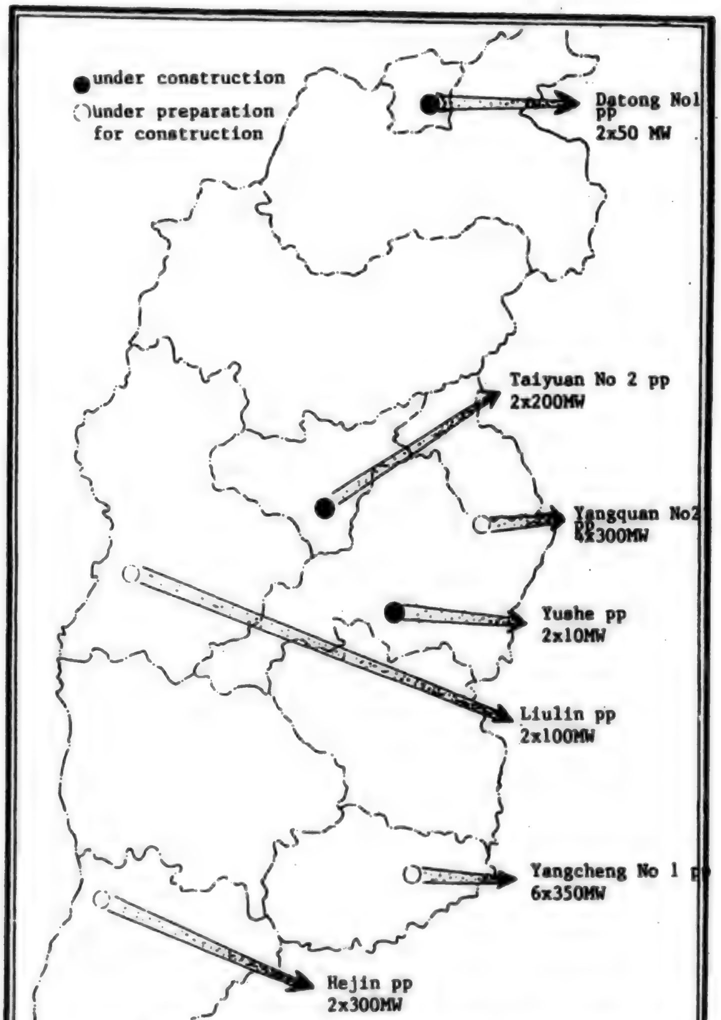
936B0113A Taiyuan SHANXI RIBAO in Chinese 5 Jun 93 p 1

[Article by reporter Shang Pusheng [1424 2528 3932]] and "China Power" reporters Yang Shuxiang [1424 2528 3932] and Lei Jiande [7191 1696 1795]]

[Text] This is the first year of Shanxi Province's campaign for coal power and transportation, and it is the key year in the Eighth 5-Year Plan. [passage omitted] A total power-plant installed capacity of 3,500MW to 4,100MW is under construction, getting under construction, or in preparation for construction this year, with a planned capital construction investment of 2 billion yuan for the largest number of new units under construction in Shanxi in a single year since China's reconstruction.

At this point, Shanxi's electric power construction projects are progressing smoothly. The 4th-stage expansion of the Taiyuan No 2 power plant will have a total installed capacity of 2X200MW. Since breaking ground for construction on 28 December 1991, the No 7 unit is finished, the No 8 unit structure is 80 percent completed; the 210-meter-high stack is finished; the coal conveyor system is finished, the loading bridge is finished; the No 1 cooling tower is now 124 meters high and the No 2 tower is up to 25 meters; all of the auxiliary shops have been built and the inside and outside installations are underway. Other installations are progressing apace, and this November the No 7 unit will complete its 72-hour full-operational test runs, and in June of next year the No 8 unit will have completed its 72-hour full test run.

The Yangquan No 2 power plant will have an installed capacity of 4X300MW. on 28 October last year, the construction units began their "5-way levelling" work. Now, the 1.6 million cubic meters of earth-leveling work is



Plants under construction or being readied for construction this year

正在建设和准备开工建设的电厂示意图

basically completed; large-scale rock blasting was done in two parts this year on 15 March and 22 May; on 28 March tests for the building area were begun, piling tests were completed on 3 April, load tests in mid May, and construction was to begin formally in July.

The installed capacity of the Yushe power plant will be 2X100MW. Work began on 15 September last year, and the footings for the main building were up to level and back fill was more than 80 percent done; foundations for the main auxiliary facilities were poured; the foundation for the chimney is up to level; the coal conveyer building was finished; the coal crusher, the unloading pits, and coal conveyer are being stepped up; and power supply will be hooked up by the end of the year.

Work on the Liulin power plant with 2X100MW installed capacity is being accelerated; the Sanchuanhe highway bridge is finished; construction for rail lines and water supply in the plant zone are under way; power for telecommunications is hooked up; and leveling and associated hauling for the plant compound are now underway. [passage omitted]

Energy Ministry Pushes Greater Use of Coal Ash

936B0112A Shanghai WEN HUI BAO in Chinese 24 Jun 93 p 1

[Article by reporter Chen Wei [7115 1919]]

[Text] A seminar jointly organized by the State Economics and Trade Commission and the Ministry of Power Industry was held yesterday in Shanghai to discuss the consolidated uses of coal ash in the nation. It was revealed in the seminar that in 1992 the total annual consolidated consumption of coal ash by the nation's power plants is 25.47 million tons, an increase of 14.19 million tons from the figure for 1987, or an average annual increase of 17.7 percent. The percentage of consolidated usage of coal ash has jumped from 23.5 percent in 1987 to 31.9 percent. Over 20 percent of the power stations in the nation have a coal ash consolidated usage percentage reaching or exceeding 100 percent. From 1988 to 1992, a cumulative 940 million tons of coal ash has been used in consolidated usage. This is equivalent to an investment saving of 1 billion yuan in coal ash storage facilities and a saving of 170,000 mu of storage space.

At present, the usage of coal ash in the nation is still a critical problem. According to reports, the nation's power generation industry has an annual installed capacity increase of 15 million to 17 million kilowatts. This will produce an annual 120 million tons of coal ash by the year 2000. If the coal ash is not put to good use, not only will the nation have to spend billions of yuan in investment money in storage facilities but also will have to add 200,000 mu of storage space. Last October, a leading comrade of the State Council instructed that coal ash usage be undertaken seriously and with greater effort. The comrade said that it is of great significance to expand the use of coal ash. Shi Wanpeng, deputy director of the State Economics and Trade Commission, pointed out during the seminar that for the usage of coal ash, the policy to insist on as the guiding principle is "emphasize usage." Also, one must make adjustments to fit local conditions, adopt multi-channel, multi-users approach and give incentives to users. Also the policy is to hold the producer of the coal ash responsible for the disposal of the coal ash and to reward the user of the coal ash. The aim is to expand usage, expand consumption and raise the percentage of usage. The forecast is to use 35 million tons of coal ash, or better still, aim at 40 million tons, by the year 1995. By the year 2000, the usage of coal ash is 50 million tons with a higher target of 60 million tons.

Update on Yimin Coal-Fired Power Project

936B0112D Beijing RENMIN RIBAO OVERSEAS EDITION in Chinese 24 Jul 93 p 1

[Article by reporters Ling Guangzhi and Wu Shuguang]

[Text] New China News Agency, Hohhot, 23 July—Construction work on the Yimin coal-fired power project, China's largest coal-fired project, and also one of the key projects of the Eighth 5-Year Plan, is in high gear. The Yimin Coal and Power Company is China's first coal-and-power joint enterprise. This is an exploratory first step in China's effort to develop energy. That means the traditional way of dividing energy development into different business fields is broken. Instead, one single enterprise will undertake coal mining and at the same time be in charge of large power plants with the ultimate goal of exporting electricity. The objective of the project, located in the Hulunbei grassland, is to build a large enterprise capable of an annual output of 20 million tons of coal and with an installed capacity of 4 million kilowatts.

Li Shun, general manager of the Yimin Coal and Power Company, said the Yimin coal field has rich reserves of brown coal. The reserve is verified to be some 5 billion tons. Phase I of the Yimin coal and power project consists of the building of a strip mine capable of an annual output of 5 million tons and the installation of two 500 MW units at a total investment of 5.2 billion yuan. Phase II of the project will be completed by the year 2000 and when completed, will boost the annual output of the strip mine to 10 million tons and power generation capacity to 2 million kilowatts. By that time, the Yimin Coal and Power Company will be able to export an annual 12 billion kilowatt-hours of power to the nation's northeast region, a base of heavy industry, and will effectively relieve the power crunch of the region.

Yumen Hits More Oil and Gas Layers

936B0112B Beijing ZHONGGUO KEXUE BAO [CHINESE SCIENCE NEWS] in Chinese 5 Jul 93 p 2

[Text] Under the auspices of the Oil Exploration and Science Research Institute of the China Oil and Natural Gas Company and the Yumen Oil Management Bureau, a study was made on the geological and geochemical structure of the geosyncline in the basin to the east of Jiuquan and successive layers of sandstone syncline were found in the mature oil-producing geosyncline among the Jurassic and Cretaceous sedimentary systems in the south. From this discovery, it is estimated that a relatively rich reserve of oil and natural gas may be found in the rock strata of Cretaceous and Jurassic systems.

An exploratory well was drilled at a location 30 kilometers southeast of Jiuquan. The well is 4,700 meters deep and indications of oil and natural gas were found in the Lower Jurassic and Lower Cretaceous rock systems. The oil and natural gas layer measures several tens of meters in thickness. In the evening of 22 May, a strong gust of oil shot up some 30 meters with a daily output of 30 cubic meters. The oil produced is relatively light with a relative gravity of 0.83. Testing and observation of the oil is still in progress.

Pipeline To Tap Tarim Basin

40100104A Beijing CHINA DAILY (Business Weekly) in English 30 Aug 93 p 1

[Article by Wei Min: "Pipeline To Tap Desert Basin"]

[Text] China is planning to build a long-distance pipeline to transport crude oil from the Tarim desert basin, called China's last frontier, to the country's industrial heartland in the east.

Construction of the pipeline, which would require an investment of at least 10 billion yuan ($1.75 billion), is an important part of China's energy development strategy.

Wang Tao, President of the China National Petroleum Corporation (CNPC), revealed last week that the pipeline is now in the design phase.

According to oil experts several billion tons of crude oil are contained in the basin, which covers 560,000 square kilometres of desert in the remote autonomous region of Xinjiang.

For years people have been worried about how the crude oil would be transported to other parts of China and other countries.

Wang did not say when construction of the pipeline will be kicked off, but added foreign investment is welcome.

"We ourselves can finance the pipeline, but we may use foreign investment," Wang said.

Business Weekly has learned that several foreign firms have showed interest in financing the pipeline.

In the short term, China will double track the railway from Urumqi, Xinjiang's capital, to Lanzhou, capital of Gansu Province.

The double-track railway will be completed in 1995, Wang said.

He said more than 10 million tons of crude oil will be produced this year in Xinjiang, mainly from the three basins of Tarim, Turpan-Hami and Junggar.

As more oilfields are developed there, the output will increase.

In 1992, 8.2 million tons of crude oil were pumped in Xinjiang.

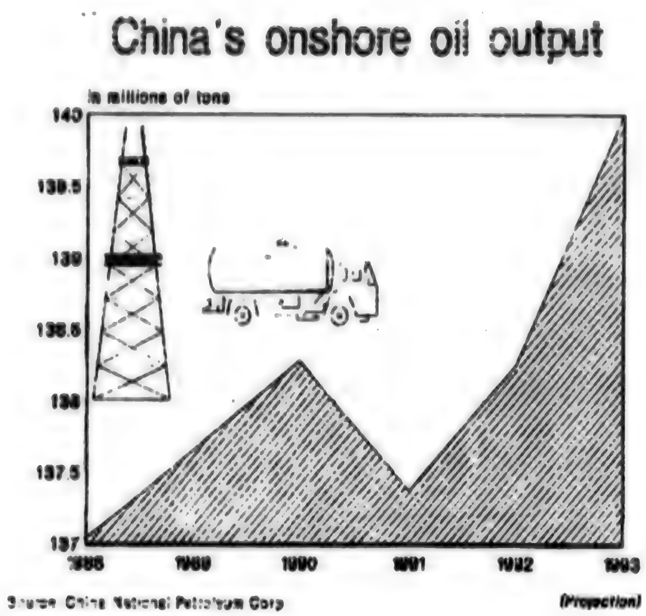
This year, oil output in Tarim will be 1.65 million tons, compared with 890,000 tons in 1992.

In Turpan-Hami, 1 million tons of oil will be produced this year.

In Junggar an oilfield with a capacity of 1.2 million tons of oil annually is now under construction.

The pipeline, together with the double-track railway, will greatly benefit Chinese and foreign oil companies in Tarim, CNPC officials said.

Sixty-eight oil firms from 17 countries have applied to enter Tarim's 73,000-square-kilometre southeastern section for exploration and development.



Oil, Gas Production Up Over Same Period in '92

936B0123A Beijing RENMIN RIBAO OVERSEAS EDITION in Chinese 25 Aug 93 p 1

[Article by reporter Xu Zhengzhong]

[Text] Beijing, 24 Aug—Due to the vigorous implementation of the strategic policy of "Stabilizing the East and Developing the West," China's land-based oil production has seen sustained and stable development in recent years. Oil production for the first half of the year is 68.98 million tons, an increase of 600,000 tons over the same period last year. Natural gas production for the first half of the year is 7.63 billion cubic meters, an increase of 90 million cubic meters.

This was disclosed to the domestic and international press community by Wang Tao, general manager of the China Oil and Natural Gas Company, during a press conference held today in the Information Office of the State Council.

Wang Tao added that on the basis of the current production trend, this year's total oil production is expected to reach 140 million tons, assuming there are no major natural disasters or other unexpected accidents in the next few months. This will mean that the production goal for 1995 as outlined in the nation's Eighth 5-Year Plan is achieved 2 years ahead of schedule.

On the subject of oil exploration, Wang Tao added that exploration work has been making encouraging progress in the eastern part of the country which has been under development over the last few years and also in the peripheral areas. Important exploration results have been achieved in the Sanshao area of Heilongjiang Province, in Songhua Jiang and Ruanjiang area in Jilin Province, in western Liaoning Province, in the Linnan area of the Shengli oil field in Shandong Province, in the Kailu and Erlian areas of Inner Mongolia and in the Tanhai area in Bohai.

Exploration in the less-than-fully-developed western region has been encouraging, particularly in areas rich in oil and natural gas such as the Tarim, Junggar and Turpan-Hami basins. It is expected that the next few years will witness a peak growth rate in oil reserves. For the Tarim Basin, regional exploration work is under way. Six oil and natural gas fields have been explored and preliminarily explored in the northern and central part of the Tarim Basin. Moreover, a series of oil- and natural gas-bearing geological structures have been discovered and verified. So far, four oil fields such as the Lunnan oil field have been in production. Oil production this year will be 1.65 million tons. In the Turpan-Hami Basin, an oil-bearing structure has been verified and 11 oil and natural gas fields have been discovered. Moreover, three other oil fields such as the Shanshan oil field are under development. The production this year is 1 million tons of oil. In the Junggar Basin, a comprehensive oil field has been verified in the

Wucaiwan area, in the eastern part of the basin. Construction work is under way to make it capable of producing 1 million tons of oil. In the desert area of the basin, several high-production oil and natural gas wells were drilled in succession, indicating good prospects for the existence and discovery of large oil and natural gas reserves.

When asked about the opening of the oil field to foreigners, Wang Tao said that as of January this year, the area/regions approved for and open to foreign cooperation in oil development have been expanded from the 11 provinces in the southern part of the country to include 10 provinces and regions in the northern part of the country. Moreover, 14 sites from 10 old oil fields such as Daqing have been selected to be opened to foreigners for co-operation in raising production efficiency. At present, the first round of open bidding to foreigners in the development of the Tarim Basin is running smoothly; 68 foreign companies from 17 different countries have indicated their intention to participate. Evaluation of the bids are now under way and negotiation will soon begin.

The press was told that by 1995 China's oil and industrial crude petroleum production will reach 145 million tons and from this 19 billion cubic meters of natural gas is expected to be produced. On this basis it is hoped that total land-based oil and natural gas production will reach 200 million tons or more by the end of the century.

Daily Production at Liaohe Sets Record

936B0115B Beijing RENMIN RIBAO OVERSEAS EDITION in Chinese 4 Aug 93 p 2

[Article by reporter Duan Xinqiang [3008 1800 1730]]

[Text] Liaohe oil field, the third largest in China, improved its structure, raised efficiency, overcame a serious shortage of funds, and made unprecedented gains for production management, breaking the 40,000-metric-ton mark for daily production of crude oil, and in the last half year, confirmed geological reserves amounting to 50 million tons of petroleum, completing 83 percent of the annual plan, and newly confirmed geological reserves of natural gas reached 1 billion cubic meters, fulfilling the annual plan 100 percent.

Liaohe oil field, pushing ahead with reform, activated bids and contracts of every sort, scaled down budget items, and introduced a competitive mechanism; 27 policies items were drawn up stipulating that every savings on investments, costs, and earnings would be divided up on a 1-9 scale, giving the bureau only "one", and keeping "nine" for over-production awards, and instilled an incentive and disciplinary mechanism by making the 120,000 oil field workers accountable for their own responsibilities, rights, and benefits. As a result "production increases became the order of the day throughout the bureau, and the clicking of abacuses could be heard from top to bottom," ringing out thoughts of small investments, more production, and cutting expenses. Last year, units spent 50 million yuan to hire local trucks to do the hauling, and this year they found every means to use their own vehicles and saved every penny; the daily production of crude oil hovered around 37,000 tons for many years, but this year it was consistently above 40,500 tons; in the past the units all cried for more people, and this year not one asked for people or money, and moreover nearly 8,000 workers retired ahead of time. The Jinzhou oil workers, 1,000 short of their authorized numbers, realigned themselves without asking for a single person, and still parted with some of them to operate a tertiary industries.

Liaohe oil field will also continue to build and cultivate an internal market, better join production and labor together, raise work efficiency, and increase performance. They have now created an S&T market, an oil well market, a petroleum products market, and production elements market.

In the past, drilling teams, engineer units, and oil production crews were put together in the bureau non-competitively, and there wasn't much enthusiasm, but now contractors go out on the market to hire drillers, engineer units, and oil production crews, forcing them into higher technology and competition, and that has clearly improved labor and efficiency. Formerly it took 20 days to put down a well, and now it's only 10 days; assembling a collection and distribution station formerly took one month, and now it is finished in 10 days. It used to be that wells were drilled after prospecting was done, and now discovery wells become production wells, and oil production testing has improved the production process, and crude oil output was increased by over 300,000 tons in the last half year.

Major Progress in Exploration in Shaanxi-Gansu-Ningxia Basin

936B0115D Beijing RENMIN RIBAO OVERSEAS EDITION in Chinese 31 Jul 93 p 1

[Article by reporters Wu Guoqing [0702 0948 3237] and Wang Kui [3769 7608]]

[Text] Yinchuan, 30 Jul (XINHUA)—Major Progress has been made in exploration of a large gas field in the central Shaanxi-Gansu-Ningxia Basin. The Changqing Petroleum Prospecting Bureau, in charge of the prospecting mission, has announced the confirmation of a gas-bearing area of over 2,000 square kilometers in the central Shaanxi-Gansu-Ningxia Basin, with confirmed reserves of over 100 billion cubic meters of natural gas, the largest ready-to-go gas field in China, and among the largest in the world.

As the area of exploration in the central basin expanded, so did the extent of the gas-bearing area, especially in the northern part of the gas field, where two wells, the Shaan-150 and the Shaan-155 which produced uninterrupted flows of 1.045 million cubic meters and 738,000 cubic meters of high industrial-grade gas per day respectively, and it is hoped that a comparably rich high-production area will be had within the year.

Natural Gas Prospecting in Shaanxi-Gansu-Ningxia Basin

936B0113B Beijing RENMIN RIBAO OVERSEAS EDITION in Chinese 29 Jul 93 p 1

[Article by reporters Wu Guoqing [0702 0948 3237] and Wang Kui [3769 7607]]

[Text] Yinchuan, 28 Jul (XINHUA)—Good progress has been made in prospecting in the Shaanxi-Gansu-Ningxia Basin, and the results are startling.

According to the Deputy Chief of the Changqing Petroleum Prospecting Bureau and General Director of the Shaanxi-Gansu-Ningxia Basin Gas-Prospecting Directorate, Lei Farui, prospectors have confirmed a gas bearing area of over 2,000 square kilometers of the central basin, making this the largest confirmed gas field ready for exploitation in China, and it takes its place among the world's largest gas fields.

In 1991 and 1992 the Changqing Petroleum Prospecting Bureau completed over 2,000 surface kilometers of seismic survey in the central basin, and drilled over 100 exploratory wells, most of which yielded industrial-grade gas, achieved a prospecting success rate of over 70 percent, and from Qingbian to Hengshan confirmed the existence of a large, moderate to low yield, low-grade gas field ready for exploitation.

In the last year, the prospecting outlook continued promising, and the prospecting target for the year is well in hand. Especially in the northern part of the gas field has prospecting been notable, where two wells, the Shen-150 and Shen-155, each had a daily uninterrupted flow of 1.045 million cubic meters and 738,000 cubic meters of high-industrial-grade gas, and it is hoped that within the year a high-yield zone will be found there.

Japan-Taiwan Discussion on Reactor Water Chemistry

93FE0900A Taipei HENENG TIENTI [NUCLEAR CLIMATE MONTHLY] in Chinese No 5, May 93 pp 26-29

[Article by Lai Wengui [6351 2429 6311] of the Institute of Industrial Materials of the Institute of Industrial Research: "Japan-Taiwan Discussion on Reactor Water Chemistry"]

[Text] The use of nuclear power and nuclear technology makes Taiwan one of the highly capital intensive, technology intensive industrial nations in the world. In view of the fact that Taiwan still needs to develop certain technologies in material science, water chemistry and electrochemistry, the spirit of cooperation and striving for excellence exhibited by the Japanese in the meeting should be regarded as a model.

The Japan-Taiwan reactor water chemistry discussion meeting was held in Taipei on 6-7 January in the conference room of the Taiwan Electric Power Building. The Japanese presented seven papers and the Taiwanese presented five. The Taiwanese delegation consisted of 70 people from Taiwan Electric Power, the Institute of Nuclear Research, Chinghua University, the Atomic Energy Commission and the Institute of Industrial Materials of the Industrial Research Institute. The Japanese delegation consisted of 11 people, headed by Professor Ishigure of the department of nuclear engineering of the University of Tokyo. The remaining members came from the Atomic Energy Commission of Japan, universities, Mitsubishi Heavy Industries, Toshiba Heavy Industries, and reactor water chemistry development department heads, chief engineers, technical consultants, managers and senior engineers from other research institutions. They represent an elite force of reactor water chemistry in Japan.

Problem-Oriented Direction

Water chemistry is a means to investigate the overall reaction between water quality and component materials involving nuclear chemistry, electrochemistry and corrosion in a nuclear power plant. It is a critical factor affecting the reliability, economics, structural integrity and safety of the entire nuclear power plant. In addition to factors such as feed water purity, additives, and impurities, the quality of water is also affected by processes such as the decomposition of water to oxygen, hydrogen and hydrogen peroxide due to neutron and gamma ray irradiation near the core, corrosion products of materials coming in contact with during the heat exchange, power generation, condensation and purification cycles, and the exposure to resin and sea water in a very complex high temperature, high pressure environment. Numerous problems associated with light water reactors are caused by improper handling of water quality.

In past decades, Professor Ishigure pointed out that a unique characteristic of water chemistry is that it is problem-oriented. For instance, water chemistry was asked to solve problems after IGSCC (inter granular stress corrosion cracking) of stainless steel and high radiation dosage exposure were found in BWRs. Another unique characteristic of water chemistry is that it is considered as a standardizing or unifying solution. If a certain water chemistry can solve a specific problem in a particular plant, other power plants will rush into adopting the same water quality without any regard to any difference in design, structural materials and operating history. He pointed out that all nuclear power plants have their unique characteristics. They are all different in certain aspects. The most appropriate water chemistry may differ from plant to plant.

To this end, each power plant should choose its own optimal water chemistry from available technology, i.e., reactor specific water chemistry, or tailored water chemistry. In order to achieve this goal, Professor Ishigure believes that it is necessary to first understand the role water chemistry plays in the entire system, then to interpret such effects and phenomena based on water chemistry, and finally to elevate water chemistry from a problem-oriented technology to a higher level preventive and predictive technology. Therefore, more progressive power plants are installing water quality monitoring systems that provide rapid and accurate measurements to detect the actual situation in real time.

Radiation Reduction Experience

In addition, computer simulation will help us analyze and understand these complex effects observed. Finally, fundamental research in related basic disciplines such as thermodynamics, surface chemistry, electrochemistry, nuclear chemistry and colloidal chemistry, especially in high-pressure, high-temperature aqueous environments, must be intensified in order to provide a solid foundation for understanding the interaction between power plant water quality and materials.

Today, the development of water chemistry technology and implementation of water quality control and solutions to problems associated with reactor cooling water have four major objectives: (1) to reduce radiation exposure to reactor operators, (2) to ensure the integrity of reactor equipment, plumbing and structure, (3) to ensure the structural integrity of the fuel assembly, and (4) to minimize the production of radioactive waste. Papers presented by the Japanese, such as water chemistry technology, advantages of hydrogen-added water chemistry, radiation reduction experience in Japanese BWR, primary and secondary PWR water chemistry, decontamination of retired reactor, and BWR on-line ion chromatography, are all related to such objectives.

Based on a survey of radiation exposure of reactor operators in Japan over the past decade, the Japanese BWR was exposed to a far higher radiation dosage than that in our power plant between 1978 and 1983. In recent years, radiation exposure fell substantially. This is due to progress in BWR water chemistry control technology. Professor Ishigure also pointed out that the rate of production of radioactive waste also follows the same tendency. As a result of years of effort, it has also been reduced to far below that of the average worldwide. The emphasis of these Japanese papers is on reducing radiation exposure and minimizing nuclear waste production.

BWR Improvement Method

The radioactive source on the surface of the pipe primarily comes from radioactive nuclides formed by corrosion products that flow through the core. They precipitate on the pipe and accumulate with surface corrosion products. It primarily takes place in the recirculating water and boiler water purification systems and threatens maintenance personnel. The main radioactive nuclides include Co-60, Fe-59, Mn-54 and Cr-51. Table 1 shows how the Japanese lowered their BWR radiation exposure. Several important aspects are described as follows:

(1) Iron rust is reduced by lowering the undissolved iron content in feed water and using erosion resistant low alloy steel such as STPA-23 A387Gr.11 and SMA-41.

(2) Reduce the source of cobalt. In addition to Co-based alloys, stainless steel and Ni-based alloys contain approximately 0.2 percent of cobalt. Therefore, other than replacing Co-based alloys, it is also very important that the cobalt content in stainless steel and Ni-based alloys is reduced to below 0.05 percent.

(3) The use of a titanium alloy heat exchanger and a water pre-treatment system that filters and deionizes the cooling water not only results in the best water quality but also prevents the regeneration of chemicals in the deionizer.

(4) Surface roughness, thickness and protective nature of the oxide layer affect the precipitation of radioactive nuclides. The protective oxide layer formed on X-750 alloy at 700°C in air can suppress the radiation dosage by 15 percent.

(5) A newly developed hollow fiber filter system installed upstream of the deionizer is used to remove rust, instead of granular ion exchange resin.

(6) Install covering for the drywell and RWCU to lower the radiation exposure to maintenance and repair personnel.

(7) When the undissolved iron content in feed water is less than 1 ppb, the Ni/Fe ratio should be controlled at 0.2 to avoid the generation of Co-60 and Co-58. The most appropriate feed water iron content is 0.2-0.5 ppb.

(8) Shut down the reactor slowly. When the cooling rate is less than 15°C/h and pressure is reduced to 50 kg/cm^2, remain in this condition for 3-4 hours can reduce the dissolution of activated scale on the fuel rod into the water.

(9) Using a water jet to rinse the soft scale in the drywell can lower radiation by 30 percent.

Table 1. Improvement Measures Taken by Japan To Reduce BWR Radiation

Improvement of materials	Reducing iron scale	Low alloy steel, corrosion resistant material
	Reducing cobalt	Co-free alloys
		—pins and rolls
		—hardened surface
		Low-Co stainless steel
		—feed water heater pipe
		—reactor internal material
		Low-Co Incoloy
		—fuel assembly spring
	Titanium	Sampling system, condenser parts
	Surface pre-treatment	Electrolytic polishing, high temperature oxidation
System improvement	Water treatment system	Condenser deionizer
		—new resin
		—no regeneration
		Pre-filter
		—granular resin
		—hollow fiber resin
	Drywell covering	PLR pipe
		RWCU pipe
	Minimizing RWCU radiation	RWCU motor relocation
		Shortening RWCU loop
Improved procedures	Oxygen control	
	Ni-Fe ratio control	
	Shut down procedure improved	
	Total shut down procedure improved	Wash condenser/hot well prior to restarting

The addition of hydrogen in feed water can buffer the oxidative and corrosive environment of O_2 and H_2O_2 containing BWR water to ensure the structural integrity of major pipes and components, to avoid stress corrosion and to slow down the rate of crevice growth. The hydrogen-added water chemistry also causes an increase in steam turbine radiation, accumulation of Co-60 activity and fuel sheath hydrogen absorption. Studies have shown that IGSCC could be stopped by adding hydrogen to lower the potential of SUS304 stainless steel to -230 mV (vs. SHE). The suitable hydrogen content should be at 0.25-0.35 ppm.

PWR Primary and Secondary Water Chemistry Control

The main effort of PWR primary water quality control in Japan is focused on reducing the radiation source. LiOH and H_3BO_3 are used to control water pH. There are three criteria: (1) reducing corrosion rate in order to suppress the production of corrosion products (CP), (2) controlling the transport of CP to prevent its activation, and (3) removing CP to minimize its presence. The best control to date is to maintain the pH at around 7.3. The addition of H_2 and LiOH can minimize the production of CP.

The main objective of secondary water quality control is to ensure the integrity of the maintenance structure, i.e., to prevent IGA and IGSCC. The secondary water quality treatment in Japan has shifted from phosphate treatment to all volatile treatment (AVT). Currently, there is a tendency to use boric acid treatment. The purpose is to reduce the alkalinity of water and to remove oxygen in conjunction with N_2H_4 to reduce the occurrence of IGA, IGSCC, thinning and denting. In addition, to prevent the invasion of impurities and sea water, cooling water is filtered and deionized to ensure the integrity of the structure. The concentration of N_2H_4 should be maintained at 0.5-0.6 ppm. The initial concentration of H_3BO_3 should be at 50-500 ppm of B and the normal concentration of H_3BO_3 should be kept at 5-10 ppm of B. The total impurity level should be kept below 50 ppb. Sodium, potassium and chloride should all be below 10 ppb.

The chemistry department of the Atomic Energy Commission of Japan has attempted various chemical decontamination and electrolytic polishing methods to remove radioactive corrosion products from the reactor core, reactor, pipes, components and equipment.

Fast and accurate water quality analysis can detect any abnormality in a timely manner. This is the main purpose of installing on-line ion chromatograph on BWR in Japan. This piece of equipment can automatically analyze impurities down to the ppm level. It is an effective monitoring device that improves the reliability of the system.

Japanese Spirit Is a Good Model

Finally, the papers presented by the Japanese, on the basis of fundamental water chemistry concept and the research in the underlying basic sciences such as thermodynamics, electrochemistry, surface chemistry and corrosion, did not exceed the domain explored by American and European scientists. Nevertheless, the spirit of seeking excellence and carefulness in applying water chemistry to nuclear reactors is the basis of their advances. It is a good model to follow.

Furthermore, from the standpoint of research personnel and organization, Japan has succeeded in combining the academic community, the Atomic Energy Commission, research institutes, power plants, power plant manufacturers and instrument developers to create a cooperative force to conduct basic water chemistry research and develop the technology for a vast range of applications. Let it be a warning to our scattered research efforts.

The use of nuclear power plants and nuclear technology makes Taiwan a member of highly capital intensive, highly technology intensive industrial nations. Although we have no problem in nuclear reaction and automatic control technology, more work is urgently needed in related fields such as material science, water chemistry, electrochemistry and corrosion.

Water chemistry, material science and corrosion technology are yet to be further developed. We should actively participate in these areas by at least investing in training our people to obtain important technology, perfect design and optimal operating concept in order to control our own destiny in the direction of research to allow us to improve at a later date. Otherwise, we will be farther behind and be at the mercy of Japanese or American manufacturers. By then, the "investment" to "acquire technology" will be several fold the present research expense. The real investment is to improve our own technology under the guidance of the concept that every power plant has its own optimal water quality chemistry.

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Structural Analysis of Reactor Pressure Vessel 'O' Ring

936B0112C Beijing ZHONGGUO KEXUE BAO [CHINESE SCIENCE NEWS] in Chinese 23 Jun 93 p 4

[Text] Structural analysis procedure of the reactor pressure vessel "O" ring, developed by the China Nuclear Energy Institute, recently passed ministry-level accreditation in Chengdu. The accreditation was approved by the Sichuan Nuclear Industries Bureau which was authorized and appointed by the China Nuclear Energy Company to undertake the accreditation.

The study takes the "limited disfiguration" theory and successfully analyzes the rebouncing properties of the reactor pressure vessel "O" ring, a sealed structural component, under the conditions of recirculatory pressure load. According to reports, the study is leading the nation in the field of "internal time theory" and also reaches international standards.

The procedure is simple but involves a high level of accuracy in computation. It is suitable for use in all kinds of complicated industrial process. Moreover, because of its high level of automation and high analytical and computational power, it can be applied not only to nuclear engineering, but also to aerospace, oil and chemical engineering when it comes to analysis and design of similar structures.

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